



Uttar Pradesh Rajarshi Tandon
Open University

UGHN-121

FAMILY AND MEAL PLANNING

UGHN-121 FAMILY MEAL PLANNING

S. N.	COURSE CONTENT	Pg. no
Block: 1	Introduction to RDA and Balanced Diet and Nutrition in Pregnancy	
Unit-1:	Introduction to RDA and Balanced Diet	7
Unit-2:	Meal and Menu Planning	21
Unit-3:	Principles of Diet Therapy and Nutrition Care Process	31
Unit-4:	Adaptation of Normal Diet	48
Block: 2	Nutrition in Pregnancy, Infancy and Childhood	
Unit-5:	Nutrition in Pregnancy and Lactation	61
Unit-6:	Nutrition in Infancy and Childhood	85
Unit-7:	Nutrition in Adolescence, Adulthood and Elderly	103
Unit-8:	Weight Management	124
Block: 3	Nutrition in During Disorders and Diseases	
Unit-9:	Nutrition in Hepatic Problems	151
Unit-10:	Nutrition in Renal Diseases	172
Unit-11:	Nutrition in Gastro Intestinal Disturbances	192
Unit-12:	Nutrition in Cardiovascular Diseases	209

UGHN-121 FAMILY AND MEAL PLANNING

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UGHN-121 FAMILY AND MEAL PLANNING

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FAMILY MEAL MANAGEMENT

Proper nutrition is the foundation of a healthy life. Understanding the principles of balanced diets, nutritional requirements during different life stages, and the role of diet in managing health conditions is essential for ensuring overall well-being. The course on **Family Meal Management** is designed to equip students with comprehensive knowledge of dietary planning, nutrition through the life cycle, and diet therapy for various medical conditions.

This course is divided into multiple blocks, covering essential aspects of nutrition and dietetics. The initial block introduces students to **Recommended Dietary Allowances (RDA)** and the importance of a **balanced diet**, particularly in pregnancy. Understanding these foundational concepts helps in developing meal plans that meet the nutritional needs of individuals and families.

The course then moves to **Diet Therapy**, focusing on principles of meal and menu planning, adaptation of normal diets, and the nutrition care process. Students will gain insight into therapeutic nutrition, which plays a crucial role in managing diseases and promoting recovery.

Another vital component of this course is **Nutrition through the Life Cycle**, which explores the dietary requirements of individuals at different stages of life, including infancy, childhood, adolescence, adulthood, and old age. Special conditions such as weight management and lifestyle-related concerns are also addressed.

The final section, **Nutrition during Disorders and Diseases**, provides an in-depth understanding of medical nutrition therapy. This includes dietary modifications for hepatic problems, renal diseases, gastrointestinal disturbances, cardiovascular diseases, hormonal imbalances, and febrile conditions. Additionally, the course covers nutrition for **fitness and sports**, emphasizing the role of diet in enhancing physical performance and overall health.

By the end of this course, students will be proficient in designing balanced meal plans, implementing dietary interventions for health conditions, and understanding the scientific principles behind therapeutic nutrition. This knowledge is essential for aspiring nutritionists, dietitians, healthcare professionals, and individuals interested in promoting health and wellness through nutrition.

BLOCK-1 INTRODUCTION TO RDA AND BALANCED DIET AND NUTRITION IN PREGNANCY

INTRODUCTION

Family meal planning also known as nutritional management is a specialized form of nutritional treatment that involves the use of normal and specific diets and dietary modifications to prevent, manage, or treat various medical conditions, health issues and normal daily routine diets according to age groups. It is an essential component of healthcare that is tailored to an individual's unique needs based on their medical history, diagnosis, and nutritional requirements. The primary goal of diet therapy includes (i) Prevention: Diet therapy can be used to prevent the development of chronic diseases like diabetes, heart disease, and obesity. It often involves promoting a balanced diet and healthy lifestyle choices. (ii) Management: For individuals already diagnosed with a medical condition, diet planning plays a crucial role in managing their condition and reducing its severity. This may involve dietary restrictions, modifications, or supplementation. (iii) Treatment: In some cases, diet therapy can be a primary or adjunctive treatment for certain medical conditions. For example, in conditions like celiac disease or food allergies, eliminating specific foods from the diet is essential. (iv) Recovery: Diet therapy can support recovery after surgery, illness, or injury by providing the necessary nutrients for healing and strengthening the body. (v) Optimization: It can also be used to optimize the nutritional status of individuals, such as athletes, to enhance their performance and overall well-being. Common medical conditions and situations where diet therapy is frequently employed includes diabetes, hypertension, obesity, eating disorders, gastrointestinal disorders, kidney disease, cardiovascular diseases, cancer, food allergies, and many more. Diet planning is typically carried out by registered dietitians or nutritionists who have specialized training in medical nutrition and are qualified to provide evidence-based dietary recommendations. It plays a vital role in improving the health and well-being of individuals by harnessing the power of nutrition as a therapeutic tool.

Unit -1 This unit is based on the knowledge of recommended dietary allowances (RDA) for the all age groups. It describes the optimum nutritional requirements necessary for all age groups and gender.

Unit 2- Based on Meal and menu planning entails the strategic selection and organization of foods to create balanced, nutritious, and enjoyable meals. It involves considering factors such as dietary goals, nutritional requirements, dietary restrictions, and culinary preferences while aiming for variety and taste. In menu planning, this extends to create diverse and appealing offerings for a set period, often considering seasonal ingredients and special dietary needs. Effective meal and menu planning promote healthier eating habits, nutritional balance, and customer satisfaction in both home and foodservice settings.

Unit 3- Describes about the principles of diet therapy that revolves around individualization, evidence-based practice, and nutritional balance, modification to address specific health conditions, ongoing monitoring, and patient education. In contrast, the Nutrition Care Process is a systematic approach that involves assessment, diagnosis, intervention, monitoring, and documentation to provide personalized and effective nutrition care. Together, these principles and processes ensure that dietary recommendations are tailored to an individual's needs, based on sound scientific evidence, and continually evaluated to achieve and maintain optimal nutritional health.

Unit 4- Give details about the adaptation of a normal diet that involves making dietary modifications to suit an individual's specific needs or circumstances. This can include adjusting portion sizes,

altering food textures for individuals with swallowing difficulties, accommodating dietary restrictions such as vegetarianism or food allergies, or addressing medical conditions like diabetes through carbohydrate management. The goal is to ensure that while meeting nutritional requirements, the diet aligns with the person's health goals, preferences, and any special considerations, making it a sustainable and balanced eating plan tailored to their unique circumstances.

UNIT-1 INTRODUCTION TO RDA AND BALANCED DIET

Structure

- 1.1 Introduction
- 1.2 Objectives
- 1.3 Meaning and Concept of Recommended Dietary Allowances
- 1.4 Purpose of Recommended Dietary Allowances
- 1.5 Factors Affecting Recommended Dietary Allowances
- 1.6 Requirements and Recommended Dietary Allowances for Various Age Groups
- 1.7 Exchange System
- 1.8 Dietary Diversity
- 1.9 Let us Sum up
- 1.10 Check your progress

1.1 INTRODUCTION

RDA is a set of national standard for quantities of major nutrients to be obtained from food/diet by healthy person in order to meet the physiological needs of the body.

The Dietary Allowances of nutrients for a community or population are recommended based on the current knowledge of nutritional requirements of different age and sex group and the community's food and dietary habits. These are also influenced by activity of an individual.

The RDA values are not set according to individual requirements or needs related to a particular condition or disease. These values for energy and different nutrients are intended to serve as a reference to meet the nutritional requirements of an individual. RDA's suggest the average values for nutrients intakes per day so that the requirements of all individuals in a given community can be met since there is variation between individuals and diets the experts also adds a margin of safety while suggesting RDA's.

With the help of RDA's a person's daily diet plan can be made easily taking into account the RDA suggested by the expert groups.

1.2 OBJECTIVES

The objectives of the unit are to give the student knowledge about the following: -

- 1. Define and understand the concept of RDA.
- 2. Understand the importance of RDA.
- 3. Understand the factors affecting RDA.
- 4. Will be able to know the RDA for various age groups.
- 5. The student will be able to plan balance diet with the help of RDA.
- 6. The student will understand and make use of exchange system.
- 7. Will understand the concept of Dietary Diversity.

1.3 MEANING AND CONCEPT OF RECOMMENDED DIETARY ALLOWANCES

Good Nutrition is the most important thing for a person's good health and it is essential to give guideline about the intake of various nutrients on daily basis.

Nutrient requirement can be defined as the minimum amount of the absorb nutrient that is necessary for maintaining the normal physiological function of the body. For every individual the nutrient requirements are different which depend upon various factors such as age, sex, activity etc. Median of this distribution is called Estimated Average Requirements.

Recommended Dietary is defined as "The intakes of nutrients derived from the diet by an individual for maintenance of normal physiological functions, growth and wear and tear." It is the amount of daily requirement of energy and several other nutrients based on age, sex, physical activity and physiological status which will enable person to maintain various body functions and to maintain good health.

The RDA ascertains the quantity on the nutrients to be consumed but it does not reflect the food source of the nutrient. Dietary guideline like the "food pyramid guide" gives information about the type and quantity of food to be consumed to be for maintaining health.

1.4 PURPOSE OF RECOMMENDED DIETARY ALLOWANCES

RDA can be used affectively for the following purposes.

1. For Providing Guidelines

With the help of RDA's we can understand the essentials nutritional requirements for energy and other nutrients as per physical activity, age, sex and physiological status.

2. Useful For Policy Maker

With the help of RDA's the policy planer select the strategies and design intervention program to overcome the nutritional deficiency.

3. Helpful For Government

It helps government to identify nutrients need for the population and make informed decision about food policy. The government decides the amount of food supplements and food supplies through the public distribution system.

4. For Non-Governmental Organizations

RDA is used by NGO when making decision about food supplementation in public nutrients and health programs.

5. Helpful in making daily diet plans for individuals

With the help of RDA we can make daily diet plans for any individuals according to requirements.

6. Helps in Planning Menu for Institutions

With the help of RDA menu can be planned in hostel, hospitals, canteens and prison etc. so that nutritionally adequate diet can be provided.

7. Planning Rations for the Programs

For programs such as mid-day meals, supplementary feeding programs and prophylaxis programs etc. rations need to be decided it can be done with help of RDA.

8. Designing Healthy Recipes

RDA provides a basis to design nutrient rich recipes and nutritious food products.

9. Food Product Development

RDA as a used in food industry to design various foods which meet the health need of specific group like Millet Biscuit, Sugar Free Sweets, Nutribar and Muesli etc.

10. Helpful for Food Industry

RDA helps the people who make the policies regarding food so that they can well understand the shortages of food in the community and can decide the rules regarding fortification or subsidies etc.

1.5 FACTORS AFFECTING RECOMMENDED DIETARY ALLOWANCES

There are many factors which influence the requirement of nutrients and the recommended Dietary Allowances. They are as follows: -

1. The age of an individual

Human nutritional requirement depend upon the age and sex of the individual. In infancy and childhood when the growth rate is high infants and children require nutrients for maintenance and growth. Nutrient requirement during childhood depend upon the child's growth rate. In adult hood there is no growth but the adults require nutrients for the maintenance of the body. Among adults nutrients requirement are related to the body weight and size.

2. Sex of the Individual

The nutrients requirements are different for males and females. Among women especially during the reproductive age the requirement of certain nutrient like iron is higher than those for men. Women require extra quantities of nutrients during pregnancy for appropriate foetal growth and during lactation for milk production.

There are differences in nutrient requirement even between individual of the same age, sex and body weight.

When the RDA for a given population is decided the variability in requirements is taken into account and a safety factor is included to cover the variability.

3. Bioavailability of the Nutrients

The rate of absorption or the bioavailability of nutrients can be different depending upon the nutrient and the quality of the diet. The requirements of nutrients are expressed in term of the absorbed nutrients. Absorption of nutrients from plant based diet which have extra amount of fiber is often inferior to that from diets based largely on animal foods. Inhibitory factors present in plant food like tannins, phytates and antitrypsin factors interfere with absorption of nutrients.

4. Interrelationship between Nutrients

There is relationship between metabolism and absorption of nutrient certain nutrients are better absorbed in presence of certain other nutrients. For example calcium is absorbed better in presence of vitamin D the utilization of protein is adequate in presence of enough energy intake. When energy intake is reduced protein utilization is impaired. The requirements of B complex

vitamins depend upon the intake of energy and protein. The requirement of B vitamins like thiamin, riboflavin and niacin is expressed in relation to energy requirements and that of pyridoxine is expressed in relation to protein requirement. In determining the nutrient requirement smaller doses of nutrients are administered due to understanding of interaction of nutrients.

1.6 REQUIREMENTS AND RECOMMENDED DIETARY ALLOWANCES FOR VARIOUS AGE GROUPS

Summary of RDA for Indians – ICMR – NIN - 2020

Age Group	Category of Work	Body Wt (kg)	Protein (g/d)	CHO (g/d)	Calcium (mg/d)	Magnesium (mg/d)	Iron (mg/d)	Zinc (mg/d)	Iodine (µg/d)	Thiamine (mg/d)	Riboflavin (mg/d)	Niacin (mg/d)	Vit B6 (mg/d)	Folate (µg/d)	Vit B12 (µg/d)	Vit C (mg/d)	Vit A (µg/d)	Vit D (IU/d)
Men	Sedentary	65	54.0	130	1000	440	19	17	140	1.4	2.0	14	1.9	300	2.2	80	1000	600
	Moderate									1.8	2.5	18	2.4					
	Heavy									2.3	3.2	23	3.1					
Women	Sedentary	55	46.0	130	1000	370	29	13.2	140	1.4	1.9	11	1.9	220	2.5	65	840	600
	Moderate									1.7	2.4	14	1.9					
	Heavy									2.2	3.1	18	2.4					
	Pregnant	55 + 10	+9.5 (2 nd trimester) +22.0 (3 rd trimester)	175	1000	440	27	14.5	220	2.0	2.7	+2	2.3	570	+0.25	+15	900	600
	Lactating 0-6m		+17.0	200						2.1	3.0	+5	+0.26	330				
	7-12m		+13.0	200	1200	400	23	14.1	280	2.1	2.9	+5	+0.17	330	+1.0	+50	950	600
Infants	0-6m*	5.8	8.0	55	300	30	-	-	100	0.2	0.4	2	0.1	25	1.2	20	350	400
	6-12m	8.5	10.5	95	300	75	3	2.5	130	0.4	0.6	5	0.6	85	1.2	30	350	400
Children	1-3y	12.9	12.5	130	500	90	8	3.3	90	0.7	1.1	7	0.9	120	1.2	30	390	
	4-6y	18.3	16.0	130	550	125	11	4.5	90	0.9	1.3	9	1.2	135	2.2	35	510	600
	7-9y	25.3	23.0	130	650	175	15	5.9	90	1.1	1.6	11	1.5	170	2.2	45	630	
Boys	10-12y	34.9	32	130	850	240	16	8.5	100	1.5	2.1	15	2.0	220	2.2	55	770	600
Girls	10-12y	36.4	33	130	850	250	28	8.5	100	1.4	1.9	14	1.9	225	2.2	50	790	600
Boys	13-15y	50.5	45	130	1000	345	22	14.3	140	1.9	2.7	19	2.6	285	2.2	70	930	600
Girls	13-15y	49.6	43	130	1000	340	30	12.8	140	1.6	2.2	16	2.2	245	2.2	65	890	600
Boys	16-18y	64.4	55	130	1050	400	26	17.6	140	2.2	3.1	22	3.0	340	2.2	85	1000	600
Girls	16-18y	55.7	46	130	1050	380	32	14.2	140	1.7	2.3	17	2.3	270	2.2	70	860	600

REQUIREMENTS AND RDA

To convert the nutrient requirements into recommended dietary allowances the bioavailability and individual variations must be taken into account. The RDA includes a margin of safety and takes into accounts the possible losses of nutrients during cooking and storage and it also provides additional intake against increased requirements during illness and other stages of nutritional stress. Usually RDA is 25% higher than the average of the mean requirements. The RDA of most individual is higher than their actual minimal requirement.

$$\text{RDA} = \frac{\text{Physiological minimum requirement}}{\text{Fraction of the nutrients available from the diet}} \times 1.25$$

1.4 USE OF ICMR – RDA IN PLANNING BALANCED DIET

When a balanced diet is being prepared and calculated for an individual person the RDA serves as a basis for diet planning. According to RDA the quantity of various nutrients to be given daily are decided and the diet plans can be made accordingly. The various food stuffs can be chosen from a wide variety of foods and diet can be planned in such a manner that definite amount of nutrients can be provided from that diet. It is to make sure that the individual receives the required amount of nutrients to remain healthy and disease free. This amount also takes in account the age, sex, physical activity and the physiological condition of that person.

CHECK YOUR PROGRESS EXERCISE

Q. 1 What do you understand by Recommended Dietary Allowances? Explain the benefits of RDA in planning diets.

Q. 2 Throw light on the factors that influence the Recommended Dietary Allowances.

Q. 3 Explain the purpose of Recommended Dietary Allowances.

1.7 EXCHANGE SYSTEM

Every human being has a desire to have variety of foods in his diet and even when a person is not well he/she would like to eat food as per their liking. Sometimes people find it difficult to accept changes in their regular dietary patterns which they have to make if they suffer from chronic diseases such as diabetes, heart diseases or kidney diseases. For this purpose dietitians have grouped or categorized commonly consumed food items and food preparations so that a healthy person can have variety enjoy the food and meet the nutritional requirements. A person always should eat a balanced diet in order to remain healthy and disease free.

The food exchange system is useful for planning different meals not only for normal healthy individuals but also for sick person. It provide alternative choices of foods from many food item with similar nutritional composition

Food exchange list is important to make a balance diet plan. In the food exchange system foods commonly used are group into seven main food groups on the basis of similarities in nutrient composition. When the dietitians are planning diets they select the foods from the exchange list and include the food items in the plan diet.

While making the diet plan with the help of exchange list energy and protein content of the diet is mainly calculated apart from this a balance diet can be planned with the help of exchange list. Any food within a give list can be substituted for any other in the list which provides approximately the same nutritive value.

With the use of this system nutritionally balanced meal can be easily planned by choosing adequate number of exchanges from each group.

When the energy and protein requirement are fulfilled on other nutrients requirement are likely to be met.

The seven main food groups in the food exchange system are milk, meat and pulse, vegetables, fruits, cereals, fat and sugar.

THE VARIOUS FOOD EXCHANGES LIST

For Indians food exchanges have been suggested by the Indian Dietetic Association (IDA) the exchanges given by IDA are developed and used by the following

1. Christian Medical College, Vellore
2. National Institute of Nutrition, Hyderabad.

Most food exchanges have been decided keeping in mind the food groups. One type of exchange list is where carbohydrates, proteins or fat are kept constant and approximate amount of the food/portion is varied. Foods which are rich in protein are grouped as milk, meat, nuts and oil seeds group. Carbohydrate is mainly contributed by cereals, pulses, roots, tubers and sugars.

Food Exchange Lists of the Indian Dietetic Association (IDA)

1. Cereal exchanges
2. Milk exchanges
3. Meat/Cheese exchanges
4. Pulse exchanges
5. Fruit exchanges
6. Vegetable exchanges – Group A and Group B
7. Fat exchanges

Cereals Exchanges

In cereal exchanges all foods are prepared for cereals such as wheat, rice and bread etc. These food can be exchanged/substituted for each other for example 1 medium chapathi will give us the similar amount of nutrients as 1 Idli or 1 small Dosa or 2 slices of bread.

Now if for a person 8 exchanges of cereals have been prescribed then while planning a meal different food items can be chosen from the exchange list.

1 exchange = 18-21g carbohydrates, 1-3g protein, 85 kcal

Role of Food Exchanges in Meal Planning

Item	Raw (g)	Approx cooked wt (g)	Household measure (cooked)
Rice	25 (2 Tbsp)	75	½ cup
Rice flour	25 (2 Tbsp)	–	–
Idlii	–	50	1 medium
Dosa	–	50	1 small
Wheat flour	25 (3 ¹ / ₂ Tbsp)	–	–
Chapathi	–	25	1 medium
Sooji	25 (2 Tbsp)	75	½ cup
Ragi flour	25 (3 ¹ / ₂ Tbsp)	75	½ cup
Bread	–	25	2 slices
Oats	25 (3 ¹ / ₂ Tbsp)	75	½ cup
Cornflakes	25 (5 Tbsp)	–	½ cup
Vermicelli	25 (2 ¹ / ₂ Tbsp)	75	½ cup
Sago	25 (3 Tbsp)	75	½ cup
Noodles	25	75	½ cup
Rice, Puffed/Flakes	–	1 cup	
Potato	100	–	½ cup
Yam	75	–	¼ cup
Sweet potato	75	–	¼ cup
Colocasia	100	–	½ cup
Tapioca	50	–	¼ cup

Milk Exchange

In Milk exchange liquid milk and milk products such as curd and milk powder are included. For example 100 ml liquid milk is equivalent to ½ cup of curd or 3 tsp of whole milk powder. All these food are good sources of essentials nutrients such as protein and calcium.

1 exchange = 4 g carbohydrates, 1-2 g protein, 4 g fat, 65 kcal.

Item	Amount	Household measure
Whole milk, cow's	100 ml	½ cup
Curd	100 ml	½ cup
*Skimmed milk	200 ml	1 cup
Whole milk powder	13 g	3 tsp
*Skimmed milk powder	18 g	5 tsp
Buffalo's milk	50 ml	¼ cup

Meat/Cheese Exchanges

In this exchange all the non-vegetarian food and cheese or paneer are included. The vegetarian individuals can choose from cheese or paneer and the non-vegetarian can choose from a variety of non-vegetarian food products.

1 Meat exchange =85 kcal, 7.5 – 18 g protein and 6 g Fat (Carbohydrate, Fat and Protein vary widely among the different foods in this group)

Item	Amount
Chicken	75g
Fish	75-100 g
Egg	1 medium
Meat	50g
Paneer (cottage cheese)	35g (3tbsp)
Beef/Pork	75g

Pulse Exchanges

In this exchange any type of pulse or dals or their products can be used. For example Sprouted or Fermented pulses or pulse flour or basan etc. For an adult individual 2-3 pulse exchanges can be included.

1 Exchanges = 15g Carbohydrate, 6 g protein, Fat negligible

Item	Amount	Household measure
All pulses and legumes	25 g	½ cup cooked
Dals	25 g	¾ cup cooked

Fruit Exchanges

With the help of food exchange system the nutritive value of various kinds of food can be compared and determined after this during diet plan fruit can be selected from the exchange list.

Item	Amount
Amla	4-5
Apple	1 small
Banana	½ small
Dates	2
Grapes	20
Guava	1 medium size
Mango	1 small
Melon	1 slice
Orange	1 medium
Ripe Papaya	2" x 3" slice
Pear	1 small
Pineapple	1 slice
Strawberries	1 cup
Watermelon	1 slice (200g)

Vegetable Exchanges

Commonly consumed vegetables are grouped into 2 exchanges first Group A and second Group B both group includes 100g of raw vegetables or half cup of cooked vegetables. Vegetables can be selected as per individual choice and availability.

Group A	Group B
30 kcals per 100 g 1 exchange = 100 g or ½ cup cooked CHO up to 6%	50 to 60 kcals per 100 g 1 exchange = 100 g or ½ cup cooked CHO up to 6-12%, Protein 2-3 g
Cabbage	Agathi
Brinjal	Beetroot

Cauliflower	Carrot
Mint	Drumstick leaves
Spinach	Onion
White Radish	Ginger
Leafy Greens	Jackfruit
Cucumber	Broad, Cluster and Double beans
Capsicum	
French beans	
Mushrooms	
Ladies finger	
Tomato	
Pumpkin	
Gourds	
Drumsticks	

Fat Exchanges

1 g of all types of fat and oil provides 9 kcal. Any type of fat can be chosen for daily cooking.

Item	Amount	Household measures
Oil- any variety	10 g	3 tsp
Ghee/Vanaspati	10 g	2 tsp
Butter	10 g	2 ½ tsp
Margarine	10 g	

Role of Food Exchanges in Meal Planning

The dietitians or the people who are planning diets can select mix and match foods from each exchange list according to individual food preferences and cost and still have equivalent nutritional value. It is usually used in diet planning for weight control, diabetes and other conditions.

The requirement for energy and other nutrients must be assessed first the energy has to be calculated for each person. For other nutrients the recommended dietary allowances used. Food exchanges are

handy tools as once understood diet planning can be simplified.

CHECK YOUR PROGRESS EXERCISE

Q. 1 What do you understand by Exchange System? How it can be helpful in planning diets for an individuals or institutions?

Q. 2 How the planned diets can be made more nutritious and full of variety through use of Exchange Systems?

Q. 3 Explain the role of Food Exchanges in meal planning.

1.8 Dietary Diversity

Diet place an important role in maintaining good health and prevention of diseases when a person is eating balanced diet his immunity is increased and he can fight of various infections and remain disease free. Unhealthy eating habits, consumption of high fat, sugar and salt (HFSS foods) and lack of physical activity can lead to increase in the prevalence of overweight and obesity. This can give rise to many non communicable diseases like diabetes, hyper tension and cardio vascular disease.

All the nutrients have different roles in a person's body. In order to get all the nutrients in adequate amounts a person must consumed a variety of food items which come from all the different food groups.



Dietary Diversity refers to the variety different foods and food groups a person or household consume over a given period. If a person or family consume a wide variety of food items they likely to get a wide range of essential nutrients. If a person is having a wide variety of food containing the entire food group it indicates that he is consuming a nutritionally adequate diet.

Definition

Dietary Diversity gives us the knowledge about the number of food items a person or a family may have consumed in a definite time. It is a qualitative measure that reflects the variety of food consumed rather than the quantity.

Importance

If a person has to have good health and immunity to fight of diseases he must have wide expect rum of nutrient in his diet. For this it is essential for an individual to get food from the various following food groups.

1. Cereals and cereals product
2. Pulses and Beans
3. Vegetables
4. Fruits
5. Meat and Milk products
6. Sugar, Honey and Jaggery
7. Fats and Oils

If a person takes one or two food items daily from each of these food groups his diet can be said to have diversity.

There are many population segments which depends on starchy foods and their diet is lacking in other nutrients giving a knowledge of dietary diversity ensures that individuals receive a wide range of macronutrients (protein, carbohydrates, and fats) and micronutrients (vitamins and minerals).



Measurement of Dietary Diversity

The dietary diversity is measured by the following two methods: -

1. Minimum Dietary Diversity (MDD)

For measuring dietary diversity through this method a specific time period is taken such as a day, week, fortnight or a month. A population segment is selected for whom the dietary diversity is assessed. The MDD calculates the minimum numbers of food groups that have been consumed in that period of time. It is often used for children age 6-23 months.

2. The Dietary Diversity Score (DDS)

It is calculated by summing the number of food group consumed in a given period of time.

Benefits of Dietary Diversity

A diverse diet has following benefits-

1. Better growth
2. Improved health outcomes
3. Development in children
4. Reduce risk of chronic diseases
5. Overall improved nutritional status

1.10 CHECK YOUR PROGRESS EXERCISE

Q. 1 What is meant by Dietary Diversity? Explain its benefits in detail.

Q. 2 How can be assessed the extent of Dietary Diversity in a group of individuals or a population segment?

Q.3 How can Dietary Diversity be helpful in bringing about better nutritional status in the community?

UNIT-2 MEAL AND MENU PLANNING

Structure

- 2.1 Introduction
- 2.2 Meal Planning
- 2.3 Characteristics of Meal Planning
- 2.4 Importance of Meal Planning
- 2.5 Factors Affecting Meal Planning
- 2.6 Food Groups and Adequate/or Balanced Diets
- 2.7 Types of Menu
 - 2.7.1 Cyclic
 - 2.7.2 À La Carte
 - 2.7.3 Hybrid
- 2.8 Let Us Sum Up
- 2.9 Progress Check Questions

2.1 INTRODUCTION

In this chapter, you will learn about the importance of meals and menu planning in weight loss. You will also learn the goals and factors that affect your eating plan and how to classify foods into different groups based on their nutrient content. It is important to include these food groups in your daily diet to provide a balanced diet.

This knowledge is necessary to eat the right foods in the right amount. In this lesson, you'll learn how to make sure the foods you eat every day are nutritionally adequate and how to plan for them.

OBJECTIVES

After studying this unit, you should be able to:

- Explain the importance of meal and menu planning;
- Identify the objective of meal and menu planning;
- Define the factors that affect the meal planning;
- Categorize foods into food groups on the basis of their nutrients;
- Menu types and importance.

2.2 MEAL PLANNING

Meal planning means planning meals that provide all the nutrients in the required amount and proportions, i. e. providing adequate nutrition. Your family's happiness and health depend on how well you eat. Achieving this is a challenge for all meal planners, but when done well, it's a satisfying and rewarding experience. In addition to other factors such as digestibility, palatability, economy, family customs, religious affiliations and food preferences, it also determines whether food is actually available and accessible to the individual.

2.3 CHARACTERISTICS OF MEAL PLANNING

First of all, you must remember that food must taste good before it can be nutritious. Most people won't eat something they don't like, even if it has high nutritional value. It should be remembered that appetite is a pleasant expectation of food, which depends not only on the feeling of hunger, but also on the taste, texture, appearance and attractiveness of the food, the comfort of the surroundings and the happy state of mind. In this way, meal planning is both an art and a science. It is an art that skilfully combine colours, textures and flavours, and a science in choosing wise foods for optimal nutrition and digestion.

2.4 IMPORTANCE OF MEAL PLANNING

Meal planning helps individuals and families maximize their physical, time, and financial resources to obtain meals that help meet their physical, social, and psychological needs. It is very important to plan family meals and to meet their nutritional needs. This is necessary to keep the body strong, healthy and protected from all kinds of diseases and deficiencies. Meal planning is very important because it saves time, effort and fuel. When planning meals, one can carefully follow procedures to maximize nutrient retention and minimize losses. Family can plan your meals according to their budget. Spending money is the best possible way, one can get the most out of it, and can have a rich diet without buying expensive foods. Meal planning allows you to choose different foods from the same food group and avoid monotony. Also, from a nutritional point of view, it is important to use different ingredients.

OBJECTIVES OF MEAL PLANNING

1. To meet the nutritional needs of the family.
2. Keep expenses within your family's food budget.
3. Consider each member's dietary preferences.
4. Use cooking methods that retain maximum nutrients.
5. Saving time, fuel and energy.
6. Serve attractive and appetizing dishes.

2.5 FACTORS AFFECTING MEAL PLANNING

Whether it's the simplest family meal or an elaborate corporate dinner, meal planning requires many factors to consider. These are:

1. Nutritional adequacy:

Food patterns should meet the needs of the family so that the nutritional needs of each member of the family are met. These requirements vary from person to person depending on age, gender, activity and physiological state, so each family member should be considered. The best way is to ensure that diet is nutritionally adequate and one should choose foods from all five food groups. Just because different family members have different needs doesn't mean that food should be cooked differently for everyone in the family. However, planning meals can help to meet the nutritional needs of all members while still cooking the same food. For example: By increasing or decreasing the number of certain foods by including additional protein foods in preparation for the growing season. For example, the same salad can be prepared for overweight and underweight family members by removing the dressing.

2. Economy:

The amount of money available depending upon socio-economic status also affects meal planning. Most of the income is spent on food. Therefore, there is a need to be frugal to get the most out of it. Although the budget of a middle-income family may not be able to afford a high-class meal, it can still provide opportunities for variety and choice. Low-income families have more limited options in their food budgets and may increasingly need to rely on grain foods for a major or significant portion of their diet. The problem is to complement these grains with the necessary nutrients for a balanced diet. It may be harder to plan, but it is still possible. Therefore, it is important to know the nutritious and cheaper alternatives to the more expensive recommended foods. Such recipes and foods should be included in food preparations such as using a combination of legumes like khichri and paushtik roti along with seasonal vegetables.

3. The facilities and help available:

The time spent in cooking depends on the use of pre-prepared foods, the use of labor-saving devices, other equipments, and the availability of helpers. But time, like money, needs a budget to make the most of it. Time management in food preparation is essential for housewives who work outside the home.

4. Satiety Value:

Each meal should make feel full enough so that one doesn't feel hungry until the next meal. Protein and fat are more filling than carbohydrates. A breakfast of tea and toast won't keep you full until lunch, but a breakfast of milk, cereal, eggs, and fruit will keep full until lunch.

5. Personal likes and dislikes:

It is necessary to follow the recommended dietary allowances for each food class, there is room for personal preference within each food category. Some people use personal likes and dislikes as the sole basis for including or excluding certain foods from their diet, and it is common not to include milk. It is always better to modify the food than to remove it completely. For example, they give milk in the form of curd, cheese, custard or other sweet foods and soybeans in the form of soy flour chapatis mixed with wheat flour.

6. Religion, traditions and customs:

They are important in determining the foods in the diet, the types of meals and the foods served to family members. For example, Muslims do not eat pork, while Hindus do not eat beef. Rice is considered an auspicious food in celebrations and weddings. In Bengal widows are not usually offered fish. Therefore, when planning family meals, one should pay attention to religion, traditions and customs.

7. Food fads and fallacies:

Often advertised based on useful nutritional information. When planning the meals one should try to eliminate these fads so that the infamous foods are served.

8. Availability of foods stuffs and climate:

In the past, diet relied largely on foods produced in specific regions or communities, today methods of food storage and distribution have improved so that even the most perishable foods are available over large areas. Dietary patterns vary widely around the world, depending largely on available food resources and climate. Therefore, only seasonal foods should be included in the diet. Seasons should also be considered when it comes to the type of foods to choose. This might include something like

hot soup on a cold winter's day or a cold salad or juice in the summer.

9. Variety:

This is very important because no one likes to eat their favorite food over and over again. Therefore, to introduce variety, avoid repeating the same foods in the daily diet. Also, the versatility of meal planning means that many types and classes of dishes are offered in delightful color combinations, with a logical mix of soft and crunchy foods, dull and spicy flavors, cold and warm foods. It ensures better nutrition and becomes more interesting food with attractive texture, color, taste and appearance that stimulates the appetite and delights the taste buds. Different cooking methods also make a difference, such as a meal consisting of tandoori roti, dal, seasonal greens and a crunchy salad.

10. Schedules of family members:

When planning meals, family's schedule (time schedule) should be considered, i. e. when and how many meals are eaten at home and outside. When making bento, it is needed to change the menu so that things can be packed and still taste good even when the weather is cold.

11. Family size and composition:

The dishes that can be served vary depending on the number of family members. It is known that when the family income is constant, as the number of family members increases, the cost of food per person decreases. Staple foods such as wheat and rice are bought in large quantities, but the amount of milk, vegetables and fruits is reduced. Therefore, the quality of the diet is affected. Family structure affects the type and amount of temperament required and the pattern of food provided. For example, if a child is under 5 years old, he cannot drink a lot of milk at once, so he will need more milk and more meals. As the child grows, their eating patterns may change to accommodate school hours, lunches and snacks need to be prepared. Elderly members of the family may need to change the consistency of their diet due to bad teeth.

12. Meal Times:

It is also an important element in meal planning. Meals should be planned based on meal timings such as breakfast, lunch and dinner. Typically, when one plans a meal for the day, you'll find that 1/3 of the daily needs come from lunch, 1/3 from dinner, and 1/3 from breakfast and afternoon tea. However, this is not an exact plan and can be modified depending on individual needs.

13. Occasion:

When it comes to daily meals, it is important to prioritize nutritional value. But in certain cases, special emphasis should be placed on the color, appearance and number of dishes included, but at the same time, the nutritional value cannot be ignored. Likewise, every festival has special dishes that should always be given importance. Like sweets for diwali, cakes for christmas, sewian for eid, etc.

2.6 FOOD GROUPS AND ADEQUATE/OR BALANCED DIETS

Food has three basic physiological functions: energy supply, body formation, and protective/regulatory functions. Foods perform these functions through the specific nutrients they contain. For example, foods rich in carbohydrates, fat, or both provide energy. Similarly, protein-rich foods help build up body, in other words, add new tissue and repair worn-out tissue. Vitamins and minerals in foods help prevent disease. As it was already discussed that this is called coordination of bodily functions. Therefore, foods can be divided into three categories based on their function:

Group 1: Foods that give energy

Group 2: Foods that build your body

Group 3: Protected/regulated foods

The energizing group includes three types of food:

High-carbohydrate foods A: cereals, root vegetables, tubers

High-carbohydrate foods B: sweet food

• **Fatty foods:** fats, oils, nuts, oil seeds.

The main nutrients provided by these are carbohydrates/fats. In addition to carbohydrates, cereals also provide protein, vitamins and minerals. Similarly, fats and oils provide fat-soluble vitamins in addition to fats.

The bodybuilding group includes protein-rich foods. The group includes:

- Milk and dairy products
- Meat, fish, chicken
- Pulse
- Eggs
- Nuts, oil seeds.

The main nutrient to get from all of these foods are protein. These foods also contain several other nutrients in significant amounts. For example, nuts and oilseeds are good sources of fat in addition to protein.

The third food group is called the protected/regulatory group. The main nutrients provided by this group of foods are vitamins and minerals. Foods that fall into the protected/regulated category includes:

Fruit:

- Yellow or orange fruits (mango, papaya, etc.)
- Citrus fruits (lemon, lime, orange, etc.)
- Others (plums, bananas, etc.)

Vegetables:

- Green and yellow vegetables (spinach, fenugreek, mustard leaves, etc.)
- Yellow or orange vegetables (carrots, pumpkins, etc.)
- Others (ladies' fingers, eggplant, cauliflower, cabbage, etc.)

Green leafy vegetables and yellow and orange fruits are especially rich in carotene/vitamin C and minerals.

This is a simple classification. However, it is useful for meal/diet planning and is the most commonly used classification. It is necessary to ensure that all meals contain food from groups that provide energy, build and protect/regulate the body.

2.7 TYPES OF MENU

There are three main types of menus used in Diet – cyclic, a la carte and hybrid.

2. 7. 1 Cyclic

A menu with different meal options for the cyclic period, typically 1 – 4 weeks. This type of menu provides a set number of choices for each meal service and the menu is repeated at the end of the cyclic.

- Can be used in acute healthcare settings, but most common in facilities with a longer length of stay.
- Usually used with multi portion meal solutions, but not exclusive to this.
- Provides a choice of meal accompaniments and portion sizes, allowing more flexibility for patients. This is particularly useful for children's wards.
- Perception of greater choice over a period as the variety of meals change each day.
- Less menu fatigue reported.

Advantages of a Cyclic Menu

The use of cyclic menu offers several advantages to food service operations in a variety of settings such as schools, hospitals, and restaurants. The main advantages of using cyclic menus are:

1. Efficiency: Cyclic menus have proven to be a solution that uses materials and resources efficiently. Optimize inventory management and reduce food waste by planning your menu in advance. Additionally, kitchen staff can run the same recipes over and over in a cyclic, allowing them to prepare meals faster and improve operational efficiency.

2. Reduce food waste: By using cyclic menus, you can plan your menu in advance, optimize the use of ingredients and reduce food waste. Menu items are repeated over a specific period of time, allowing for better inventory control and allowing kitchen staff to more accurately plan the quantities of ingredients needed.

3. Cost-effective: Cyclic menus allow for better inventory management and efficient use of staff resources, helping to control costs. Cyclic menus allow kitchen staff to plan the amount of ingredients needed, reducing the risk of over-ordering and waste. In addition, with pre-designed menu items, one can better manage food costs and optimize the use of resources such as time and energy.

4. Improved nutrition and portion control: By pre-planning menu items, cyclic menus ensure that customers get the nutrients and portion sizes they need at each meal. Menus can be customized to suit different dietary needs and restrictions, ensuring that all customers receive a meal that meets their dietary needs.

5. Efficient use of kitchen resources and staff: Similar to table point menus, cyclic menus allow efficient use of kitchen resources and staff. Planning menu items in advance allows kitchen staff to plan their tasks more effectively and ensure that dietary demands are met. It also allows kitchen staff to prepare ingredients in advance, reducing the time required to prepare each meal.

Disadvantages of a Cyclic Menu

Although menu cyclics offer several advantages to foodservice operations, there are some potential drawbacks to consider. Here are some of the major disadvantages of using cyclic menus.

1. Lack of variety in taste: Although cyclic menus offer a wide range of meals, some customers feel that repetitive menu items can become monotonous over time. As a result, it may be dissatisfied with the taste of food.

2. **Limited flexibility:** unlike a la carte menus that offer a variety of dishes to customers, cyclic menus are pre-designed and repeated at a specific time interval, reducing the ability to adapt to customer changes. Changes in demand, material availability, or season. This can be challenging for food service operations that need more flexibility in their menus.

3. **Complexity of menu planning:** Developing and implementing cyclic menus can be complex and require careful planning, organization and coordination. Designing a menu that meets the nutritional needs of customers, accommodate a variety of dietary needs and restrictions, and provides balanced and varied meals throughout the cyclic can be difficult.

4. **Staff training and coordination:** Implementing cyclic menus requires kitchen staff coordination to ensure they are familiar with menu items, can prepare them effectively, and maintain food quality, and training is necessary.

5. **Increased initial costs:** Cyclic menu development requires an initial investment in planning, recipe development, and training. This can increase initial costs and can be difficult for some food service operations.

2. 7. 2 À la Carte

The menu is the same every day with a wide selection of defined food options.

- Mainly used in acute care settings, especially in short-stay facilities and to meet special dietary needs.
- Usually includes, but is not limited to, serving refrigerated or frozen food solutions.
- Offer more meal options per service to help patients find their favorite meals.
- Provides flexibility and speed to provide meals outside of standard service hours (eg 24-hour menu, A&E and maternity meal provision).
- Menu types that offer diets that cannot be included in a standard menu, such as allergy-free textures, religious and cultural diets.
- Long-term patients can cause menu fatigue

Advantages of an A La Carte Menu

- **Increased customer flexibility:** A la carte menus allow customers to choose exactly what and how much they want to eat. Meals can be customized according to taste and choose foods that fit with dietary restrictions and preferences.
- **Lots of options:** A la carte menus usually offer a wide range of options, from appetizers and entrees to entrees and desserts. This is especially appealing to customers who want to try different foods or are looking for a specific type of food.
- **High quality ingredients:** With an à la carte menu, our restaurants use fresh ingredients to prepare each dish. Since customers pay for each item separately, restaurants try to use the best possible ingredients to ensure customer satisfaction.

- **More control over spending:** Customers on a budget may find à la carte menus more economical because they can choose the items and quantities they order. This is useful for groups with different appetites and dietary needs.
- **Upsell Opportunities:** Selecting menus can be a great way for restaurants to increase revenue by selling additional items and promotions to customers. For example, a server might recommend unique appetizers or desserts to complement a customer's meal.

Disadvantages of an A La Carte Menu

- **High cost:** One of the main disadvantages of an à la carte menu is that it can be more expensive than other types of menus, as customers pay for each dish separately. This can limit customers on a budget or looking for a more affordable dining experience.
- **Longer waiting time:** Since each dish in the a la carte menu is prepared individually; customers may take longer to receive their food. If you are in hurry or having lunch with a lot of people, this can be a disadvantage.
- **Complexity:** A la carte menu can be more complex and difficult than other menus. Customers may be overwhelmed with options or need help deciding what to order.
- **Inconsistent portion sizes:** Since each dish on an a la carte menu is priced individually; restaurants may vary portion sizes to maximize profits. This can be frustrating for customers who believe they are not getting a fair deal or are used to fixed sizes.
- **Difficulty coordinating meals:** When customers order from an a la carte menu, it can be difficult to coordinate meals so that everyone at the table receives their meal at the same time. This may be difficult for large groups or when ordering multiple courses.

2. 7. 3 Hybrid

This menu is a combination of a la carte menu and rotating menu. Food service consists of several options available each day and a cyclic of several options that change daily (i. e. daily specials).

- Reducing the risk of menu boredom for long-term patients while increasing the range of choices for each meal service.
- Storage space, budget and operational processes must be considered to accommodate a large number of options with varying availability.

2. 8 LET US SUM UP

In this unit, we learned about the importance and necessity of food planning. I learned that meal planning means planning for proper nutrition. To ensure a balanced diet, it is required to make good food choices. Through judicious combination of colors, textures and flavors, it helps to make meals more attractive and attractive. Many factors influence meal planning, including nutritional adequacy, economic considerations, acceptability, and availability.

In the second part of the unit, the types of menus and their importance will be discussed. This section explains why to plan a menu and how it can be used to plan your daily meals.

2. 9 CHECK YOUR PROGRESS

Short Questions:

1. What is meal planning?
2. List two characteristics of meal planning.

3. Why is meal planning considered important?
4. Name one factor that can affect meal planning.
5. Define what constitutes an adequate or balanced diet.
6. Briefly explain the concept of food groups.
7. What are the types of menus commonly used in meal planning?
8. Give an example of a cyclic menu.
9. State one advantage of a hybrid menu.
10. How does à la carte menu differ from cyclic menu?

Long Questions:

1. Discuss the importance of meal planning in maintaining a healthy lifestyle. Provide three reasons to support your answer.
2. Explain how factors such as cultural preferences and dietary restrictions can influence meal planning decisions.
3. Describe the characteristics of a well-balanced diet and its significance in meal planning for different age groups.
4. Compare and contrast cyclic and à la carte menus in terms of their advantages, disadvantages, and suitability for different types of food establishments.
5. How can incorporating a hybrid menu system benefit a restaurant in terms of customer satisfaction and operational efficiency? Provide examples to illustrate your points.

Objective Questions:

1. **Which of the following is not a characteristic of meal planning?**
 - a) Flexibility
 - b) Random selection
 - c) Consideration of nutritional balance
 - d) Budget-consciousness
2. **What is one factor that can affect meal planning?**
 - a) Weather conditions
 - b) Seasonal availability of ingredients
 - c) Celestial events
 - d) Historical events
3. **A well-balanced diet typically includes:**
 - a) Excessive amounts of sugar and saturated fats
 - b) Limited variety of foods
 - c) Adequate intake of fruits, vegetables, proteins, and whole grains
 - d) Only fast-food items

4. **Which type of menu offer a variety of dishes to customers at separate prices?**
- a) Cyclic menu
 - b) À la carte menu
 - c) Hybrid menu
 - d) Buffet menu
5. **What is an advantage of a cyclic menu?**
- a) Offers extensive variety
 - b) Allows for easy customization
 - c) Simplifies inventory management
 - d) Offers flexibility in pricing
6. **What is a disadvantage of an à la carte menu?**
- a) Requires less kitchen staff
 - b) Can be confusing for customers
 - c) Reduces food waste
 - d) Increases customer satisfaction
7. **Which type of menu combines elements of both cyclic and à la carte menus?**
- a) Static menu
 - b) Dynamic menu
 - c) Hybrid menu
 - d) Fixed menu
8. **What is the primary purpose of meal planning?**
- a) To eliminate the need for cooking
 - b) To ensure nutritional balance and variety
 - c) To increase food waste
 - d) To limit customer choices

UNIT 3 : PRINCIPLES OF DIET THERAPY AND NUTRITION CARE PROCESS

Structure

- 3. 1. INTRODUCTION
- 3. 2. DIET THERAPY
 - 3. 2. 1. PRINCIPLES OF DIET THERAPY
- 3. 3 DEFINITIONS AND ROLE OF DIETITIAN IN HEALTH CARE
 - 3. 3. 1 Dietetics the Science and Art of Human Nutrition Care
 - 3. 3. 2. Role of Dietician in Health Care
 - 3. 3. 4. IMPORTANCE OF DIETITIANS
- 3. 4 ASSESMENT OF PATIENTS NUTRITIONAL NEED
 - 3. 4. 1 Types of Nutritional Assessment
 - 3. 4. 1. 1 Anthropometric Nutritional Assessment
 - 3. 4. 2 Biochemical Assessment
 - 3. 4. 3 Clinical *Nutritional Assessment*
 - 3. 4. 4 Dietary Assessment
- 3. 5 *IMPLEMENTATION AND EVALUATION OF NUTRITION CARE*
- 3. 6 NUTRITION MONITORING AND EVALUATION
- 3. 7 DIET COUNSELLING
- 3. 8 LET US SUM UP
- 3. 9. CHECK YOURPROGRESS

3. 1. INTRODUCTION

Diet is a branch of nutrition that deals with the use of food for therapeutic purposes. Diet therapy is a broad term for the practical application of nutrition as a preventive or corrective treatment for disease. A proper diet can improve and prevent diseases. It may also modifyan existing diet to promote optimal health.

In this unit, you will learn about the principles of diet and the nutritional care process, including the role and importance of a nutritionist, how to support patients, their nutritional needs, etc.

In this section the implementation and evaluation of nutritional care and diet counselling will be learned.

OBJECTIVE

After studying this unit, you will be able to:

- Describe the principles of diet therapy
- Describe the role and importance of a dietitian
- Learn how to evaluate the nutritional status of an individual.

- Plan, implement and evaluate nutritional care based on the assessment and,
- Highlight the importance of patient care and counseling,

3. 2. DIET THERAPY

Diet therapy may include prescribing a specific diet or meal plan. These special diets and food plans are called therapeutic diets. A diet refers to a food plan that controls the consumption of certain foods or nutrients. They are compatible with normal diet. Common examples of therapeutic diets include clear liquid diet, diabetic diet, renal diet, gluten-free diet, low-fat diet, and high-fiber diet. A treatment plan is usually prescribed by a nutritionist, dietitian or doctor.

3. 2. 1. PRINCIPLES OF DIET THERAPY

The principles of diet therapy are:

- Maintain good nutritional status.
- Correct defects and diseases.
- Rest if needed.
- Helps in the metabolism of nutrients.
- Change weights as needed.

3. 3 DEFINITIONS AND ROLE OF DIETITIAN IN HEALTHCARE

All of us are familiar with the term "nutritionist". Who is a nutritionist? What are the roles and responsibilities of a nutritionist in the hospital? Read and know this and more in this section. Before that, let's understand what the term nutrition means.

3. 3. 1 Dietetics the Science and Art of Human Nutrition Care

Nutrition is defined as the science and art of feeding people based on the principles of nutrition. It can also be called "the science and art of taking care of human nutrition". Nutrition is the study of using nutrition principles in planning

Diet suitable for health and disease, in other words, diet therapy and its application in patient-related environments is the main focus of nutrition science. Therefore, the field of nutrition can be related to the following:

- Nutritional care and interventions focused on the individual.
- Group-based nutritional care and interventions.

Traditionally, nutritionists have focused primarily (or almost entirely) on the biological aspects of nutrition. However, over the years it has been realized that physiological biochemistry does not provide a complete answer to human nutritional problems. Therefore, nutritionists are moving towards a comprehensive approach to human and society nutrition, and experts in various related disciplines are increasingly realizing their central role in all aspects of life.

The rapid development of scientific information is inseparable from our understanding of nature. The analysis of biological, sociological and psychological factors in human life reveals the need for a holistic or comprehensive approach to human nutrition, as it is becoming more and more common.

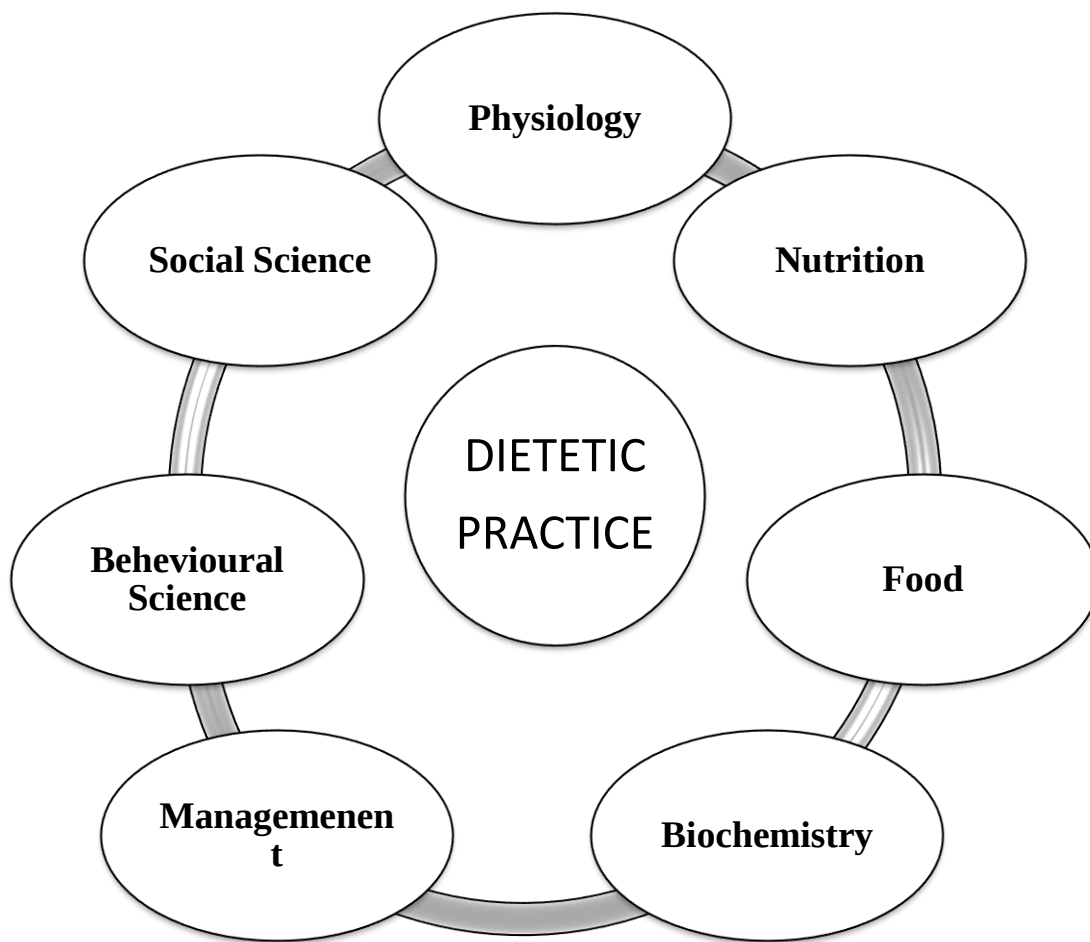


Figure 3. 1. : Dietetics - a multidisciplinary approach

**Source: Payne-Palacio J, Canter DD. The profession of dietetics, 1996*

3. 3. 2. Role of Dietitian in Health Care

The role of the nutritionist has evolved greatly since the early 1900s. Their role is still unknown to many. Some people think that dietitians, as the name suggests, only provide meals to help people lose weight, but that's only part of a dietitian's role. Nutritionists have a specific role in relation to ethical issues and dilemmas of nutritional care of the patient. Dietitians act as a bridge between patients and their medical teams or doctors, helping them make difficult decisions about nutritional care. The role of the nutritionist in the management of nutritional support for terminally ill patients is as follows: Nutritionists should continue to play an important role in the assessment and decision-making of nutritional support for terminally ill patients. Interpreting nutritional issues between the patient and other members of the health care team in this unique setting and no one is better trained. To do this, the development of new nutritional technologies, supplements, and interventions will force difficult decisions regarding the benefits of these treatments and patient preferences.

Nutritionists work in different positions and in different workplaces. Of course, the largest share is related to food services and patient care in hospitals and outpatient centers. However, some dietitians work in student food services, the hotel industry, cafeterias (industrial cafeterias), food companies, pharmaceutical companies, and even in the health services/social and public sectors. Some people are self-employed as sole traders. Today, nutritionists are also active in the field of marketing, sales and journalism. While looking at these activities, the services of nutritionist focus on:

- Clinical services
- Community public health/nutrition
- Nutrition information/communication
- Food service
- Health/disease prevention
- Nutritional research

Many nutritionists are also becoming involved in new specialties such as sports nutrition, cardiovascular fitness, general nutrition education, prenatal nutrition, and even physical therapy and rehabilitation.

Therefore, as the health needs of society change and health systems evolve to meet the developmental needs of the societies as the work and role of nutritionists is changing rapidly.

Therefore, nutritionists are required to have diverse skills. Nutritionists are expected to plan, organize, implement and evaluate nutrition education for individuals, clients and groups, so in addition to technical knowledge and practical skills, they also have communication and educational skills (oral and written).

In all these cases, nutritionists are involved in nutrition therapy, that is, not only rehabilitation, but also health promotion and health maintenance. Applying skills to communicate scientific information to different audiences at appropriate levels requires a high degree of competence. A good professional nutritionist should also have the ability to select and/or develop appropriate nutrition education materials and approaches for different target groups.

In food service systems, nutritionists have many managerial roles. Orientation of employees, training and development; counseling to subordinates, providing training in the workplace and during service and continuous training to meet the needs of employees.

Another area of the future is home health care, where patient counseling, caregiver education, documentation, diet history, and development of nutritional care plans are key activities.

Thus, nutritionists are the "helping" professionals because the services they provide benefit individuals and society and are dedicated in improving the nutritional status of individuals. A helping professional can be described as a professional who uses knowledge to do something. Communication, interpretation and application of nutrition for the benefit of human health.

Support professionals need different skills.

- Interview techniques
- Counseling techniques
- Ability to interact with individuals, groups and individuals.
- Transformative effects.
- The ability to understand yourself
- Establishing professional and interdisciplinary relationships.
- Recognition of personalities, groups and social dynamics.

If a dietitian has these skills, she can assist others or herself, be able to assess many (or all) dimensions of a problem, explore alternative solutions and stimulate action towards positive change and problem resolution.

3. 3. 4. IMPORTANCE OF DIETITIANS

Nutritionists are key members of the medical team. They demonstrate a wide range of skills as practitioners, educators, researchers, and leaders. There are many benefits of having a nutritionist as a member of your health care team.

Diet counseling by a nutritionist is more effective in the prevention and treatment of some chronic diseases than usual care with minimal dietary recommendations. For example, nutrition interventions improve the prevention and management of diabetes and heart disease-related outcomes compared to non-nutrition interventions. It has been shown that nutritional interventions carried out by a team with a nutritionist are more effective in reducing blood pressure than interventions without a nutritionist.

There are many benefits to having a nutritionist as a member of your health care team. Diet guidance by a nutritionist is more effective in preventing and treating some chronic diseases. For example, nutritionist interventions improve the prevention and management of diabetes and heart disease outcomes. Nutritional interventions performed by a team with a nutritionist also have been shown to be more effective in reducing blood pressure.

3. 4 ASSESMENT OF PATIENTS NUTRITIONAL NEED

The nutritional care process begins with the nutritional assessment. Nutrition assessment is the evaluation of an individual's nutritional status and nutrient requirements. It is a systematic process of obtaining, verifying, and interpreting data in order to make decision about the nature and cause of nutrition-related problems. It is an ongoing, dynamic process that involves not only initial data collection, but also continual reassessment and analysis of patients/clients/groups needs. The purpose of nutrition assessment is to:

- Obtain adequate information in order to identify nutrition-related problems,
- Define accurately an individual's nutritional status,
- Determine the level of nutritional support that individuals need, and
- Monitor changes in the nutritional status and the effect of nutritional intervention.

How is this done? It is based on review of dietary history, medical history, symptoms, and interpretation of information obtained from physical and clinical examinations, including anthropometric measurements and laboratory data. This process is often referred to as an "ABCD" analysis.

A stasnds for Anthropometric measures: It measures growth in children and shows changes in weight in all populations that can reflect diseases and help to monitor progress in fat loss or gain

B for Biochemical investigations: These help to reveal nutrients and metabolites in blood and /or urine, and/or faces that indicate an infection or a disease.

C for Clinical analysis: This analysis includes a complete physical examination and a medical history. The physical examination begins with the patient's general appearance. Nutrition-oriented aspects of the physical examination focus on the skin, head, hair, eyes, mouth, nails, extremities, abdomen, skeletal muscle and fat stores.

D for Diet history and nutrient intake: This is used to evaluate diet for nutrient or food intake. Common methods used include the 24-hour diet recall, diet history, food frequency questionnaire, weighment method etc.

Nutritional assessment is important in the nutrition care process because acute and chronic

malnutrition (both under and over nutrition) are common clinical findings. Malnutrition, we know, interferes with an individual's growth, development, general health and recovery from illness.

Objectives of nutritional assessment

- Obtained detailed information on the prevalence and geographic distribution of nutritional problems in specific communities.
- Identification of an individual or group of individuals.
- People at risk of malnutrition.
- People who are already malnourished.
- Develop health care programs.
- Begin measuring the effectiveness of nutrition programs and interventions.

Importance of Nutritional Assessment

A nutritional assessment can help you know what to eat and what not to eat to live a healthy life. Let's look at other reasons why nutritional assessment should be a priority.

1. Nutritional assessment help people understand their dietary intake and compare it to the recommended daily intakes of nutrients.
2. Regular nutritional assessments can identify potential risks associated with malnutrition.
3. Help people make decisions about dietary changes.
4. A nutritional assessment will give information about certain foods that should not be eaten.
5. It help us learn how to plan a meal and snacks in advance so one should not have to rely on fast food or other convenient options.
6. Regular nutritional assessment is the only way to ensure that body is getting enough nutrients from daily diet in the right amount.

How often should nutrition assessment be done?

The frequency of nutritional assessment depends on the client's age, pregnancy, disease status, and national policies. The following recommendations should be adjusted according to nutritional guidelines.

- a) Pregnant women/postpartum: prenatal visits.
- b) Infants 0-6 months: at birth and at every scheduled visit after birth.
- c) Infants 6 to 59 months: during growth monitoring sessions, monthly if they are less than 2 years old, and every 3 months if they are older.
- d) Children 5 years and older: per visit.
- e) Adolescents and adults: every time they visit the clinic.
- f) HIV-infected persons: at all visits to the clinic and when starting or changing antiretroviral therapy (ART).

3. 4. 1 TYPES OF NUTRITIONAL ASSESSMENT

3. 4. 1. 1 Anthropometric Nutritional Assessment

Anthropometric measurements are noninvasive quantitative measurements of the body and provide a valuable assessment of nutritional status in children and adults. Typically includes body size, weight and fit measurements.

Anthropometric measurements are commonly used in pediatric populations to assess general health, nutritional adequacy, and patterns of growth and development in children. An important part of this type of nutritional assessment is measuring people's weight and calculating their BMI to see if they are in the optimal range.

Common anthropometric measurements include:

- BMI
- Waist
- Height
- Weight
- Thickness of subcutaneous fat
- Bone mineral density
- Blood pressure
- Heart beat
- Body fat percentage
- Other measures of obesity
- Muscle mass
- Fat-free body mass
- Fat-free body mass
- Total water content in the body.
- Visceral fat
- Fasting blood sugar level
- Fat profile

Advantages of anthropometric assessment

- It uses simple, safe and non-invasive methods.
- Anthropometric assessment techniques can be applied to large samples.
- Target with high sensitivity and specificity.
- Can be performed by healthcare professionals without specialized training.

Disadvantages of anthropometric assessment

- Anthropometric assessment covers the diagnosis of restricted nutrition.
- Anthropometric measurements cannot detect protein or micronutrient deficiencies or detect small disturbances in nutritional status

3. 4. 1. 2 Biochemical Assessment

A biochemical assessment involves checking the levels of nutrients in a person's blood, urine, or stool, usually through laboratory tests. These lab tests can help trained doctors discover medical problems that affects thenutritional status and appetite. For example, researchers may take a blood sample to measure glucose levels in the body.

During a complete biochemical evaluation, the doctor checks the following biochemical parameters: albumin, prealbumin, CRP, transferrin, hemoglobin, urea and creatinine, lymphocytes and point defects.

Advantages of biochemical evaluation

- Early detection of signs of malnutrition and nutritional deficiencies in the body.
- Biochemical assessment also confirms nutritional status and/or clinical diagnosis of disease risk.

Disadvantages of biochemical evaluation

- It takes time.
- Health care professionals should perform several biological tests for correct diagnosis.

3. 4. 1. 3 Clinical Nutritional Assessment

Clinical evaluation is the easiest and most practical way to confirm the patient's nutritional status. In this case, the doctor examines certain areas of the patient's body to find signs of defects. Clinical nutrition assessment involves asking patients if they have symptoms that indicate nutritional deficiencies.

Advantages of clinical evaluation

- Helps healthcare professionals navigate metabolic changes in the body.

Disadvantages of clinical evaluation

- It's expensive.
- Provides only limited data on food ingredients.

3. 4. 1. 4 Dietary Assessment

Dietary assessment is the process of collecting information about what a person eats and drinks over a period of time. In other words, it's a record of the food consumed to calculate potential nutrient intake.

During a dietary assessment, health care professionals use food composition tables to analyze energy, nutrients, and other components of the diet.

The purpose of dietary assessment is to identify areas for appropriate and practical changes in the patient's diet and lifestyle to improve the patient's overall health. For a detailed analysis, healthcare professionals may perform one or more of the following procedures:

- Diet record
- 24-hour call
- Meal frequency questionnaire

Benefits of dietary assessment

- Provides textual information about personal nutritional intake.

- Dietary assessment results are more accurate because foods and portion sizes are described in more detail.

Disadvantages of dietary assessment

- Relies on accurate memory of food intake over long periods of time.
- Food frequency questionnaires are prone to misreporting, especially when health care professionals use them to collect data.

Nutritional Assessment Tools

Let's take a look at some of the tools that healthcare professionals use to determine a person's nutritional needs.

Meal frequency questionnaire

- The food frequency questionnaire is a tool that helps in regularly recording the frequency of consumption of certain foods. You will also be asked questions about your eating habits. This information will be compared with national guidelines and standards.
- Meal frequency questionnaires help to keep a track of what to eat on a regular basis. It can be fill out at home or can be brought at doctor's office. The answers obtained will help doctor to make the right decisions about nutritional status.
- When filling out the dietary questionnaire, write down everything which have eaten in the past 24 hours. It includes all drinks including water, milk, juice, soda, tea, coffee, alcohol and other drinks. Also, be careful if you skip meals. If someone is not sure if something has been eaten, please put an "X" next to it.

Calorie calculator

- A calorie calculator allows us to enter the number of calories burn per day. Then, based on weight, age, gender, height, and activity level, it determines how many calories are needed per day for a healthy life.
- The calorie calculator only works based on the entered measurements. For example, some people may forget snacks like cookies, crackers, and potato chips when counting calories. And they underestimate the calories which they burn during exercise. Such inaccurate measurements ultimately affect the quality of information obtained from the calculator.

To use the calorie calculator, follow these steps:

1. Enter your current weight.
2. Choose from five different activity levels. The higher the level, the more intense workout is.
3. Select the number of days to be calculated for daily calorie requirement.
4. Click on Calculate.
5. Check the results and adjust if necessary.
6. Print the results

The Food Pyramid

The food pyramid explain show many servings of grains, vegetables, fruits, dairy products, meat and oil should be consumed each day. Each section represents a specific type of food. For example, the top of the pyramid tells how much whole-wheat bread, pasta, rice, cereal, oatmeal, and potatoes should be consumed. The bottom section tells how much fruit, vegetables, fish, meat, and eggs you

should eat.

Form Plus

Form plus is a data collection tool that allows to create questionnaires for nutritional assessment. There are several features that helps to collect data from respondents seamlessly and conveniently.

Let's take a look at some of the reasons why one should use form plus to assess your nutrition.

1. Create mobile friendly forms

Form plus let us create mobile-friendly nutrition assessment forms that can be completed on any device, including smartphones, laptops, and notebooks. Form plus forms provide an optimized user experience and adapt to any device they are viewed on.

2. Easy to use drag and drop form builder

Form plus makes it super easy to create online interview form templates in minutes with our drag and drop form builder. Even without technical knowledge. First click or drag and drop the form fields into the form builder to add nutrition assessment form.

3. Analysis and reporting

The form analysis functionality allows to easily process form responses collected through nutrition assessment forms. The analytics dashboard allows to view information about form responses, such as the total number of submissions, average form response time, and the device used to fill out the form.

4. Multiple form field options

Form plus has over 30 dynamic form fields that allows to collect a variety of information from patients, starting from health information to file upload. This means that all the information needed to perform an objective nutritional assessment can be gathered in a short period of time.

3.5 IMPLEMENTATION AND EVALUATION OF NUTRITION CARE

To provide the highest quality of care as a nutritionist, you need to be vigilant and somewhat like a detective. The nutritional care process provides a structured approach that can be individualized to meet the needs of each patient or client. The Nutrition Care Process Framework supports decision-making and critical thinking while ensuring efficient and effective care delivery. There are always procedures and processes in place to guide and ensure quality while providing maximum care and love to clients and patients.

Steps in the nutritional care process

The nutritional care process consists of four steps that support from initial assessment to follow-up care planning. The four stages include:

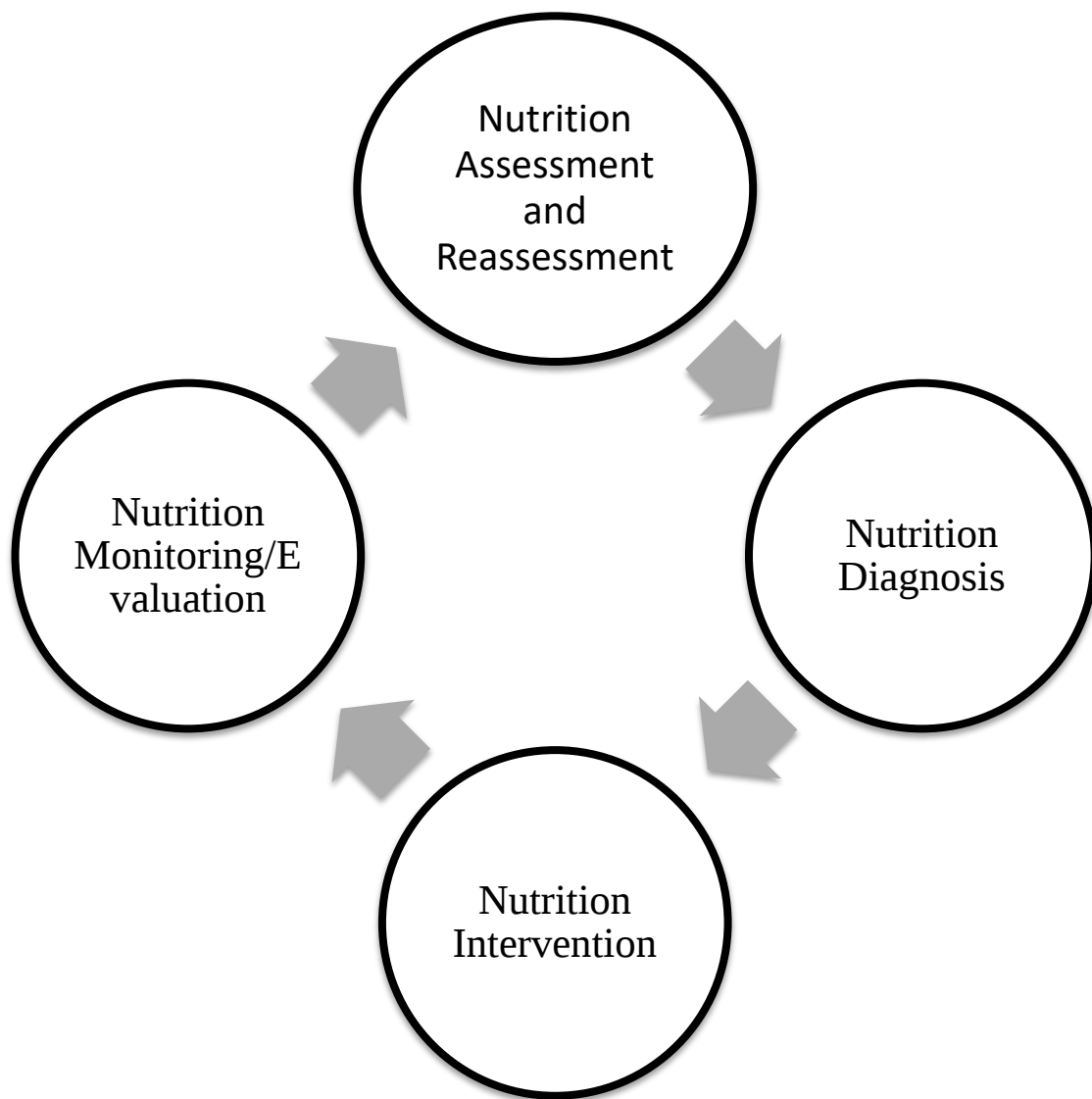


Figure 2. 2. Steps involve in nutritional care process

Step 1: Nutrition Assessment

Nutrition assessment consists of two parts. Part 1 is the initial assessment, basic data collection, context, and history, and data analysis and interpretation. Part 2 is a reassessment where a cyclic called the nutritional care process begins again.

Important dates collected during a nutritional assessment include:

Food/Nutrition History:

- Meal and snack pattern
- Sufficient intake/change in appetite
- Nausea, vomiting
- History of heavy drinking or defecation.
- Physical activity pattern
- Availability of food.

- Allergies/food preferences

Customer history:

- Medicine/surgery
- Use of drugs/supplements/dietary drugs
- Vital signs/current medical history.
- Social and economic status
- Excretory habits, history of laxative use

Anthropometric data / measurements:

- Height
- Weight (active, normal, ideal)

Body mass index (BMI)

- Intentional or unintentional weight change.

Medical procedures, test data, test results:

- Research on gastric emptying
- Bone scan
- Electrolytes
- Glucose/hemoglobin A1C
- Lipid panel

Nutrition-focused health review:

- Overall muscle tissue, fat storage

Oral cavity (tongue, gums, lips, mucous membranes, etc.)

- General appearance

After initial data collection, history and background, factors influencing nutritional and health status are considered and evaluated. After evaluating the data, the next step is to identify the problem or diagnose the nutrition.

Step 2: Nutrition Diagnosis

A nutrition diagnosis identifies nutritional problems that a nutritionist responsible for treating it. From the data collected and analyzed by the nutrition department, the evaluator can determine what the nutrition diagnosis is. Once the diagnosis is understood, recommendations can be made to the patient. From there, the patient or client can work with their doctor to set goals to move toward improving their health. When creating a nutritional diagnosis statement, specific nutritional diagnostic terms and causes, signs, and symptoms are identified.

Nutrition certificate has three parts.

1. The nutritional problem or diagnosis explains the change in the client's condition.
2. Etiology is the pathophysiological, situational, developmental, cultural and/or environmental factor that causes the problem.
3. Signs and symptoms that support the existence of a nutritional diagnosis

Diagnosis of nutrition should be clear, concise and always specific to the patient or client being treated. Example of a nutritional diagnosis: Disturbed eating patterns related to harmful beliefs about food and nutrition are evidenced by reports of restrictive behaviors and abuse of laxatives to remove nutrients from the body.

Step 3: Nutrition Intervention

Nutritional interventions are a set of planned actions aimed at helping the recovery process. Interventions may support changes in nutrition-related behaviors, risk factors, environmental conditions, and health status. When deciding on nutritional intervention, is it toward a nutritional diagnosis or resolution of a nutritional cause? Start planning there, make sure the client is engaged, and then implement the nutritional intervention. All nutritional interventions must be intellectual, special, measurable, achievable, relevant and based on time.

Step 4: Nutrition Monitoring and Evaluation

Nutritional monitoring and evaluation are a time for a re-evaluation process. In essence, this brings us back to square one. When reassessing the client, review all self-monitoring data and records to assess progress and whether current goals and interventions are being met. This goes back to the cyclic we call the nutritional care plan.

Back to Step 1: Reassessment

After completing the initial nutrition assessment, the next step is to plan and complete the reassessment. During reassessment, all the data are reviewed, past goals are considered, and the patient or client works together to identify what they feel is going well and what has been more difficult. When working with patients or clients, make sure working with them exactly as it should be. Physicians, should act as guide as patients and clients progress toward recovery. During a reassessment, clinicians reassess whether goals are being met and whether adjustments or modifications to nutritional goals or diagnoses are necessary.

This cyclic continues if the nutritionist recognizes the need for ongoing nutritional care. This is also the time to identify when the patient or client is ready to move on to another level of care or discharge.

3.6 NUTRITION MONITORING AND EVALUATION

Monitoring and evaluation are an essential step in the nutritional care process and is very important too. Monitoring specifically refers to the review and measurement of the patient/client/group status at a predetermined follow-up point with regards to the nutritional diagnosis, intervention plan, goals and outcomes. Evaluation, on the other hand, is the systematic comparison of current findings with previous status, intervention goals or a reference standard. The purpose of monitoring and evaluation is to determine the degree to which progress is being made and goals or desired outcomes of nutrition care are being met. This step makes the nutritional care plan effective and responsive to the patient's needs. It includes three distinct and interrelated processes as highlighted in Figure 2. 3.

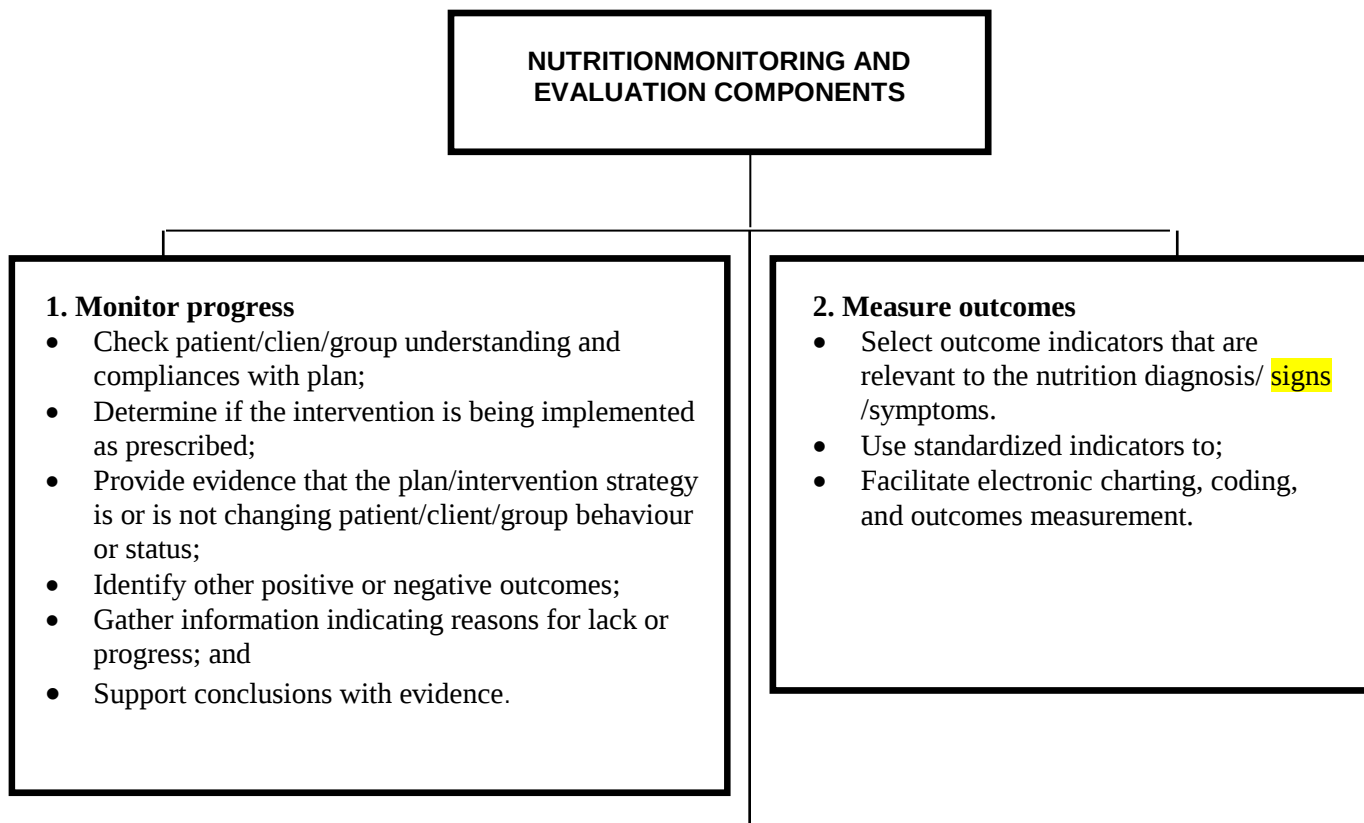
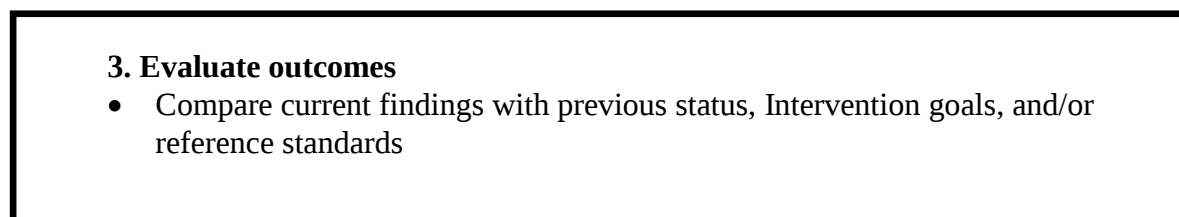


Figure 3.3. Nutrition monitoring and evaluation components



An evaluation of the extent to which the patient's nutritional requirements are being met can be done for example by means of the nutritional index (NI). This index calculates the extent to which an actual intake of a specific nutrient meets the recommended/desirable intake for a particular patient. NI can be calculated as:

$$NI = \frac{\text{Actual Intake of the Nutrient} - \text{Desirable}}{\text{Desirable Intake}}$$

Now, how to interpret the value obtained from NI. If the actual daily intake exceeds the desirable intake, the NI is stated as a positive percentage while if less than the desirable intake, then it is stated as a negative percentage. Several negative NI days is an indicator of objectives not being met and that the care needs to be evaluated and changed.

3.7 DIET COUNSELLING

Meaning

Diet counseling is advised on individual nutritional care and diet modification. This includes patient education and diet planning to help prevent and treat nutrition-related diseases. Dietary counseling

for chronic conditions is sometimes referred to as medical nutrition therapy (MNT).

Target

Nutritional counseling, which includes personal education, motivation, and meal planning, is the most effective way to encourage active patient participation. Individualized nutrition counseling provides patients with important insight into food-related diseases and educates them about how different nutrients (proteins, carbohydrates, fats) and alcohol influence obesity and disease. Nutritionists also pay attention to the consumption of micronutrients, especially vitamins and minerals. Taking too little or too much of certain vitamins and minerals can lead to nutrient deficiencies and nutrient toxicity, respectively. Dietary counseling may be customized to meet the needs of patients diagnosed with specific conditions. It can also help reduce the complications and side effects of treatment and improve your overall health.

Dietary counseling is most often used to treat obesity and obesity-related diseases, as well as diseases such as diabetes and eating disorders, but it can be useful in a wide range of situations. For example, hospice agencies routinely offer nutritional counseling to patients. The US Preventive Services Task Force recommends intensive behavioral nutritional counseling for adult patients with hyperlipidemia and risk factors for cardiovascular disease and other diet-related chronic diseases. This intensive counseling may be provided by your primary care physician or through a referral to another professional, such as a registered dietitian.

Precautions

Dietary counseling, whether provided by a registered dietitian (RD), nutritionist, physician, or other health care provider, has consistently been shown to be most effective when tailored to the individual. A "one-size-fits-all" approach to dietary advice, such as that sometimes offered in commercial weight loss programs and diet plans, is rarely effective in permanently modifying eating habits. Furthermore, dietary advice that works for one group of people may not work for other groups, especially those who are economically disadvantaged or have different cultural beliefs and practices. Age, gender, health status and various psychological factors also affect the way of giving nutritional advice to different people.

Explanation

There are many goals to consider when planning proper nutritional counseling.

- Based on weight history, physical activity level, and other factors, establishes a reasonable weight goal that both patient and counselor agree is attainable and maintainable over time.
- Providing enough calories to achieve and maintain the desired body weight for adults, ensuring normal growth and development for children and adolescents, and providing increased energy during pregnancy and breastfeeding or recovering from catabolic disease and meeting nutritional needs.
- Make sure the diet should contain adequate amounts of protein, carbohydrates, fats, vitamins and minerals.
- Achieve and maintain recommended blood lipid levels through a low-fat diet
- Prevent, delay, or treat nutrition-related risk factors and complications.
- Improve overall health through optimal nutrition

Source

- Dietary advisors often use Dietary Reference Intakes (DRIs) established by the USDA to guide macronutrient and micronutrient recommendations. The DRI also includes safe intake

limits for each nutrient. To achieve and maintain optimal or satisfactory blood lipid levels (total cholesterol, low-density lipoprotein [LDL], high-density lipoprotein [HDL], and triglycerides), guidelines provided by the National Cholesterol Education Program are commonly used.

- Both dietitians and dietitians themselves use a variety of other US government resources, including the 2015 Dietary Guidelines for Americans and the 2020 edition of Healthy People. The guidelines include 23 key recommendations for overall healthy dietary choices and 6 additional key recommendations for specific individuals. Pregnant women, etc. The three main objectives of this guideline are:
- Manage weight by balancing calories and physical activity.
- Eat more fruits, vegetables, whole grains, fat-free and low-fat dairy, and seafood.
- Reduce the intake of foods high in sodium, saturated fat, trans fat, cholesterol, added sugars, and refined grains.

Approaches

Diet advice tailored to individual needs and preferences is more useful and appropriate than general dietary advice. However, the best way to encourage patients is to follow dietary recommendations and make beneficial changes which is often unclear. Introducing positive feedback or reward systems can help some patients adhere to dietary recommendations. It is usually easier to introduce new behaviors than to remove established ones. For example, encouraging patients to start exercising regularly to lose weight may be more effective than trying to dramatically change their current eating habits. Making several small changes at once can be easier than one behavior changes because it produces faster and more noticeable results. Diet counseling should emphasize that lifestyle change is not an all-or-nothing phenomenon, and clients should not give up because of setbacks. Counselors should emphasize the importance of persistence. Because behavioral research shows that lifestyle changes are often characterized by rapid cycles of progress and regression, as well as periods of spirals and plateaus. Finally, prioritized goals are an important part of diet counseling, as it is a continuous assessment of progress.

The metatheoretical model (stages of change) is one of the most popular models for changing health behaviors. This model classifies individuals into stages based on their readiness to consider change and identify factors that can trigger a transition from one stage to the next. The use of various skill trainings and counseling at different stages has shown promising results in diet modification.

Cognitive-behavioral strategies are also used in food counseling. In cognitive behavioral therapy (CBT), counselors interact with patients as individuals.

Communicate interest, understanding, and acceptance. Provide sufficient opportunity for patients to express themselves. Counselors can determine whether a patient is ready to change their behavior, use empathy to identify less desirable eating habits, and identify situations and scenarios where patients contribute to undesirable behaviors.

3.8 LET US SUM UP

In this unit you have learned the principle of diet therapy and also have learned about dietitian, their role and importance in health care and other sectors. This unit also includes the method and steps involved in the assessment of the patient's nutrition needs, planning, implementation and evaluation of nutrition care. You have also learned about the counseling of diet

3.9 CHECK YOUR PROGRESS

Short Questions

1. Define diet therapy in one sentence.
2. List any two roles of a dietitian in healthcare.
3. Name two methods to assess a patient's nutritional status.
4. What is the first step in the Nutrition Care Process (NCP)?
5. Mention any one benefit of diet counseling.

Long Questions

1. Explain the key principles of diet therapy with examples.
2. Discuss the role and importance of dietitians in planning and implementing therapeutic diets.
3. Describe the various methods used for assessing a patient's nutritional needs.
4. Illustrate the steps involved in planning, implementing, and evaluating a nutrition care plan.
5. Elaborate on the significance of diet counseling in managing chronic diseases.

UNIT 4 : ADAPTATION OF NORMAL DIET

4. 1. INTRODUCTION

4. 2. QUALITATIVE AND QUANTITATIVE ADAPTATION

4. 3. TYPES OF DIET

4. 3. 1 Normal or General Diet

4. 3. 2 Liquid Diets

4. 3. 3 Soft Diets

4. 4. MODE OF FEEDING

4. 4. 1 Oral Feeding

4. 4. 2 Tube Feeding (Enteral Nutrition)

4. 4. 3 Parenteral Nutrition

4. 4. 4 Supplemented Feeding

4. 4. 5 Fluid Restriction or Modification

4. 4. 6 Oral

4. 4. 7 Tube Feeding

4. 4. 8 Parenteral

4. 5. LET US SUM UP

4. 6. CHECK YOUR PROGRESS

4. 1. INTRODUCTION

Normal nutrition is the basis of therapeutic reforms. The main principle of diet therapy/nutrition therapy is that it is based on the patient's natural nutritional needs. Any therapeutic regimen is simply a modification of a person's normal nutritional needs to match the needs of that person's particular condition. A person's "diet" is defined as that person's food and drink intake.

All detailed dietary changes should be accompanied by supporting information about options, clear instructions, menu guides and possible substitutions. Patients should be encouraged to understand the important relationship between food and diet. The value of a food is determined by the amount of nutrients it contains and how often it is consumed. If people are provided with clear explanations and simple instructions as to why they are needed, they are more likely to follow through on the necessary dietary changes. The Recommended Dietary Allowance (RDA) is often used as a basis for assessing the adequacy of diets. When planning a diet, one should consider the specific nutritional needs of particular disease or disorder. As a nutritionist, one must remember that a person's diet is influenced by various factors such as lifestyle, income, knowledge, taste preferences, religious beliefs and various other socio-cultural factors. Not considering these things can make the planning of treatment regimen unrealistic.

4. 2. QUALITATIVE AND QUANTITATIVE ADAPTATION

Adaptation of the usual diet can be done using quantitative or qualitative methods. In some cases, a combination of both may be required. What do these methods mean? How are they done? Read the next section to find out. Let's start with a qualitative method.

a) **Qualitative Methods:** Support information such as individual selections, clear instructions, menu guides and advice on suitable manufactured products are provided. Patients should understand the important relationship between food and diet. The value of food is determined by the amount of nutrients in it and how often it is consumed. Different qualitative methods are:

- Publication of healthy eating guidelines
- Food guide pyramid
- A list of preferred food options, and
- Elimination diet

b) **Quantitative Methods:** These are often necessary to create treatment regimens. There are two ways to do this:

- i) Use an exchange system that provides a constant amount of nutrients for each food item. An example of this is carbohydrate exchange systems used in meal planning for insulin-dependent diabetics. The desired amount of consumption is determined and a meal is created from the exchange list.
- ii) Determine the amount of food and its frequency of consumption. The diet includes portions of normal-sized foods, but foods with the highest content of a specific nutrient per serving are excluded from the diet. We also learned about this aspect earlier and learned about diets limited in fat, Na and K. It also reviews the foods that are allowed and excluded based on their nutrient content.

4. 3. TYPES OF DIET

A person's diet is the total amount of food and drink they normally consume. A diet is an attempt to achieve or maintain a certain weight by restricting food intake. People's food choices are often influenced by various factors, including moral and religious beliefs, clinical needs, and the desire to control weight.

Not all meals are healthy. Some people continue to eat unhealthy foods out of habit rather than consciously choosing unhealthy foods. The terms of this type of diet include "junk diet" and "western diet". Many diets have serious health risks, but doctors believe the long-term benefits are minimal. This is especially true for "crash" or "fad" diets, which are short-term weight loss programs that involve significant changes in a person's normal eating habits.

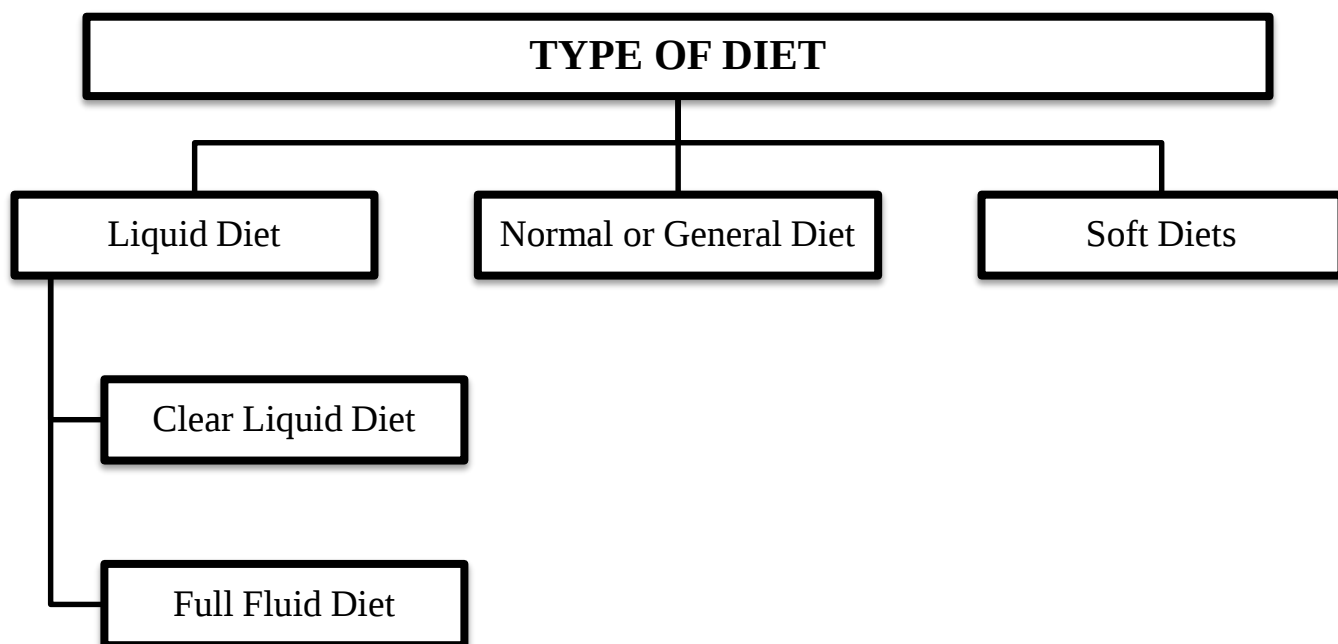


Figure 4. 1: Type of Diet

4. 3. 1 Normal or General Diet

This diet is planned to meet Recommended Dietary Allowances (RDAs) for nutrients and is based on food groups. It is usually based on periodic menus planned according to the region, type of hospital and customers. Adequacy of nutrition is determined by the patient's choice of food and the amount of food received by the patient. The role of the clinical dietitian is to monitor food selection and consumption to ensure adequate nutrition. General diets are intended for hospitalized patients whose medical conditions do not require therapeutic changes. A sample meal plan for reference is shown in Table 3. 1.

Table 4. 1: A Day's Normal Diet for an Adult

Foods	Quantity (g)	Energy (g)	Protein (g)	Carbohydrates (g)	Fats
Cereals and cereal products	370	1386.62	37	277.5	9.25
Milk and milk products (3% fat)	300	174	9	14.4	9
Pulses and legumes	75	250	17.48	42.48	2.25
Roots and Tubers	200	100	3	20	0.6
Green Leafy vegetables	100	30	3	2.5	0.5
Other vegetables	200	60	4	7	0.6
Fruits	100	45	1	10	-
Fat	25	225	-	-	25
Sugar	20	80	-	20	-
Total		~2350	~75	~394	~47

Source: Dietary Guidelines for Indians, 2011, National Institute of Nutrition, Hyderabad, India

Approximate amount of food: calories = 2350 kcal. Carbohydrates = 394 grams, protein = 75 grams, fat = 47 grams.

For non-vegetarians: 1 egg = 1/2 cup milk. 75 grams of lamb/chicken = 1 bowl of beans

+ Card bowl

This diet is used for all patients who do not need a special diet.

4. 3. 2 Liquid Diets

Liquid diets include foods that can be prepared in liquid or strained form at room temperature. These are usually prescribed after certain types of surgery. The two main types of liquid diets are clear liquid and complete liquid.

Clear Liquid Diet: This includes low-residue foods that minimize the food load that must be digested in the intestines. Clear liquid diets provide foods and liquids that are clear and liquid at room temperature. The type of fluid provided will vary depending on the patient's clinical condition, the test or diagnostic procedure, or the specific surgery the patient is undergoing. The goal of the clear liquid diet is to provide fluids and electrolytes to prevent dehydration. The diet is insufficient in terms of calories and essential nutrients. Do not use clear liquid diets as a sole source of nutrition for more than 1 to 3 days without supplemental protein, calories, vitamins, and minerals. A clear liquid diet leaves the least amount in the digestive tract. It also minimizes gastrointestinal irritation.

The diet is used as an initial feeding progression between intravenous feeding and a full liquid or solid diet that follows surgery. It could be used as a dietary preparation for bowel examination or for surgery. It is also useful at times of acute disturbance of gastrointestinal function. It has application in many illnesses characterized by a high fever.

Recommended food items include:

- Clear and fat-free soup/broth.
- Coffee, light tea (without milk or cream)
- Strained fruit juice
- Soft coconut water, whey, oat water
- Gelatin, fruit ice cream, ice cream
- Sugar and salt added to liquids.
- Carbonated drinks are acceptable.
- Commercial supplements with high protein and high calories (dissolved in drinks or water).
- Honey.
- Ice
- Do not use other foods.

Small amounts of fluids are given at frequent intervals (50 to 100 mL every 1 to 2 hours). The nutritional composition of clear liquid diets varies depending on the type and amount of liquid provided and consumed by the patient. Do not use solid foods.

Full Liquid Diet: This diet provides liquid or semi-liquid foods and liquids at room temperature. Depending on the clinical condition of the patient, the type of meals provided may be different. It is used as a step between a clear liquid diet and a regular diet.

The purpose of diet therapy is to provide oral hydration to people who are unable to chew, swallow and digest solid foods. It is used in parenteral nutrition or in combination with parenteral nutrition as an intermediate step for solid food after surgery.

If you have trouble chewing or swallowing, or if you have certain procedures such as jaw wiring. It is also used in cases of esophageal or digestive tract narrowing, during moderate inflammation of the digestive tract, and in patients with acute illness. Do not use solid foods.

Recommended food items include:

- Soup and soup
- Cereal porridge (refined cereals)
- Milk and milk drinks, yogurt
- Coffee, tea, fruit juice, carbonated drinks
- Butter, cream and oil are added to food
- Simple pudding, custard, ice cream, jelly,
- Sugar, honey, salt, mild taste.

The food composition of the diet depends on the type and amount of liquids available to the patient. This diet is deficient in iron, vitamin B12, vitamin A and thiamine. With careful planning, you can meet your maintenance needs with the exception of dietary fiber. Liquid nutritional supplements or mixture of foods is added to improve nutritional adequacy. Breastfeeding is usually done 2 to 4 hours apart. This diet is generally low in fiber and can lead to constipation if used for a long time. If long-term use is required, vitamins, iron or liquid nutritional supplements should be added.

4. 3. 3 Soft Diets

Soft meals offer soft, whole foods that are lightly seasoned and relatively low in fiber. This food has a soft texture and is easily digested. Small meals are offered until the patient's tolerance to solid foods is established.

Soft foods provide a transition between liquid and regular foods. It may be prescribed for post-operative cases, acute infections, digestive disorders or patients with chewing disorders. Soft diets should be individualized based on clinical diagnosis, surgery, patient appetite, food tolerance, previous nutritional status, ability to chew and swallow. If the patient is able to consume adequate amounts of food, soft food can be nutritionally adequate. Supplements and feeding between meals can also be used to increase nutrient intake.

Foods allowed in soft diet include:

- Soups – mildly flavored soups and creamy soups.
- Drinks – everything.
- Meat - moist, soft meat, fish or chicken, cottage cheese, eggs (except) fried in oil.
- Fats – butter, cream, oils, salad dressings.
- Milk – milk, milk drinks, yogurt.
- Cereals – soft cooked refined grains – rice, pasta, bread, porridge.
- Vegetables – cooked soft vegetables.
- Fruits - soft cooked fruits, juices.
- Dessert - custard, ice cream, jelly, cake (sponge), pudding without nuts.

- Sweets - sugar, honey, plain candy.

Foods to avoid include:

- Fried foods and nuts.
- A wide selection of sweets and desserts.
- raw vegetables.
- Spicy foods.
- Vegetables that produce gas.
- Skin and seeds of vegetables and fruits.

Avoid heavy sauces, dressings, pickles, fried foods, rich cakes and nuts. Mechanical soft food is a regular food, only the texture has been changed to make it easier to chew. This method is used when patients are unable to chew or use their facial muscles due to a variety of dental, medical and surgical conditions. Foods in the diet can be liquid, crushed, pureed or regular foods with a very soft consistency. Now that we've covered the different hospital foods, we'll finally look at the different feeding methods used for therapeutic purposes.

4. 4. MODE OF FEEDING

The mode of feeding refers to the method by which food or nutrition is delivered to an individual. Different modes of feeding are used depending on factors such as the individual's health status, nutritional needs, ability to eat orally, and clinical condition. The mode of feeding can vary from oral intake of regular foods to specialized methods such as enteral or parenteral nutrition. Here, we'll explore various modes of feeding in more detail:

4. 4. 1. Oral Feeding:

Oral feeding is the most natural and common mode of feeding, where food and fluids are consumed through the mouth. This mode of feeding is suitable for individuals who can chew, swallow, and digest food safely. It involves eating a regular diet consisting of a variety of foods from different food groups. Oral feeding is essential for maintaining hydration, providing essential nutrients, and promoting overall health and well-being.

4. 4. 2. Tube Feeding (Enteral Nutrition):

Tube feeding, also known as enteral nutrition, involves delivering liquid nutrition directly into the gastrointestinal tract through a tube. This method is used when individuals are unable to eat orally due to conditions such as dysphagia, neurological disorders, gastrointestinal dysfunction, or impaired consciousness. Tube feeding can be administered through various types of feeding tubes, such as nasogastric tubes, nasojejunal tubes, gastrostomy tubes (PEG tubes), or jejunostomy tubes. Enteral nutrition formulas are carefully formulated to provide a balanced mix of nutrients necessary for maintaining health and supporting healing and recovery.

4. 4. 3. Parenteral Nutrition:

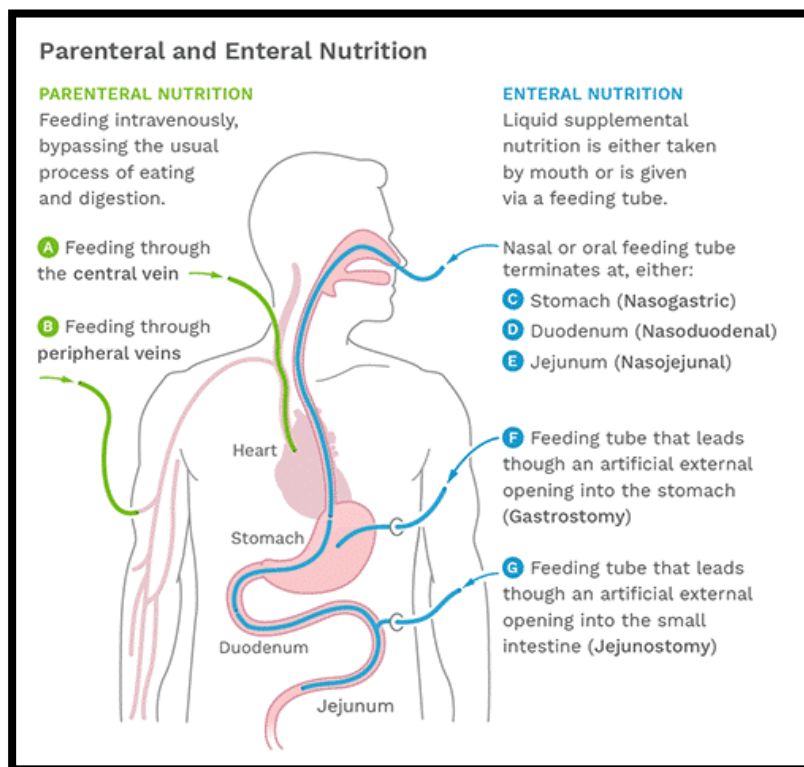
Parenteral nutrition is a method of delivering essential nutrients directly into the bloodstream through a catheter placed in a large vein. This approach bypasses the digestive system entirely and is used when individuals cannot tolerate oral or enteral feeding due to severe illness, gastrointestinal dysfunction, or other medical conditions. Parenteral nutrition solutions are carefully formulated to provide a balanced mix of nutrients, including carbohydrates, proteins, fats, vitamins, minerals, and electrolytes, tailored to the individual's specific needs. Parenteral nutrition is typically reserved for critically ill patients in hospital settings and requires close monitoring by healthcare professionals.

4. 4. 4. Supplemented Feeding:

Supplemented feeding involves providing additional nutrients or specialized formulas to supplement the individual's regular diet. This may include oral nutritional supplements, which are concentrated sources of calories, protein, vitamins, and minerals designed to address specific nutritional deficiencies or support increased energy needs. Oral nutritional supplements are often used in individuals who have difficulty meeting their nutritional requirements through regular dietary intake, such as older adults, individuals with chronic illnesses, or those recovering from surgery or injury.

4. 4. 5. Fluid Restriction or Modification:

In some cases, individuals may require restrictions or modifications to their fluid intake due to medical conditions such as heart failure, kidney disease, or electrolyte imbalances. Fluid restriction involves limiting the number of fluids consumed each day to prevent fluid overload and manage symptoms such as edema or shortness of breath. Fluid modification may involve adjusting the types of fluids consumed, such as reducing sodium intake or increasing fluid intake rich in electrolytes such as potassium or magnesium.



4. 4. 6 Oral

Oral nutritional supplements (ONS) are nutritional support products that provide an effective and non-invasive way for people to meet their nutritional needs or increase their food intake. People taking ONS can eat a normal diet, but their regular diet alone cannot meet all their nutritional needs, so they need nutritional supplements. Also, patients requiring a fluid-based diet may benefit from ONS. ONS products are often prescribed or recommended by a physician or registered dietitian. In some cases, people rely on ONS as their only source of power.

4. 4. 7 Tube Feeding

Tube feeding, also known as enteral nutrition, is a medical intervention where liquid nutrition is

delivered directly into the gastrointestinal tract through a tube. This method is typically used when a person cannot consume food orally or cannot take in enough nutrients orally to sustain themselves adequately.

There are various reasons why tube feeding might be necessary, including:

- 1. Swallowing Difficulties:** Individuals with conditions such as stroke, neurological disorders, or head and neck cancer may have difficulty swallowing safely.
- 2. Severe Malnutrition:** Tube feeding can provide essential nutrients to individuals who are unable to consume adequate nutrition orally due to various medical conditions.
- 3. Gastrointestinal Disorders:** Some gastrointestinal disorders can impair the absorption of nutrients from food, making tube feeding necessary to bypass these issues.
- 4. Trauma or Surgery:** People who have undergone certain surgeries or experienced trauma may require tube feeding during their recovery period.
- 5. Chronic Illnesses:** Conditions like cystic fibrosis or certain metabolic disorders may require specialized diets or nutritional support, which can be provided through tube feeding.

There are different types of tubes used for feeding, and the choice depends on factors such as the individual's condition, anticipated duration of tube feeding, and medical team preferences. Common types of tubes include nasogastric tubes (NG tubes), gastrostomy tubes (G-tubes), and jejunostomy tubes (J-tubes).

The process of tube feeding involves carefully selecting and preparing a nutrition formula that meets the individual's specific needs. The formula is then administered through the tube at a controlled rate using a pump or syringe. Monitoring is crucial to ensure proper nutrition intake and prevent complications such as aspiration or tube dislodgement.

While tube feeding can be a life-saving intervention for individuals who cannot consume food orally, it also requires careful management by healthcare professionals to minimize risks and ensure optimal nutrition and hydration. Additionally, support from dietitians, nurses, and other members of the healthcare team are essential to address any issues that may arise during tube feeding.

Tube feeding, also known as enteral nutrition, is a method of delivering liquid nutrition directly into the gastrointestinal tract through a tube. This approach is used when individuals are unable to consume food orally due to various medical conditions such as dysphagia, neurological disorders, gastrointestinal dysfunction, or impaired consciousness. Tube feeding provides essential nutrients, fluids, and medications to meet the patient's nutritional needs and support optimal health and well-being.

Types of Tubes:

There are several types of tubes used for enteral nutrition, each with its own placement and functionality:

- 1. Nasogastric Tube (NG Tube):** This tube is inserted through the nose and down the esophagus into the stomach. Nasogastric tubes are often used for short-term feeding or administration of medications and can be easily inserted at the bedside.
- 2. Nasojejunal Tube (NJ Tube):** Similar to an NG tube, a nasojejunal tube is inserted through the nose but is advanced further into the small intestine (jejunum) instead of stopping in the stomach. Nasojejunal tubes are used when feeding into the stomach is not feasible due to gastric motility issues or the risk of aspiration.
- 3. Gastrostomy Tube (G-Tube or PEG Tube):** A gastrostomy tube is surgically placed through the

abdominal wall directly into the stomach. It is used for long-term enteral feeding in individuals who require nutritional support for an extended period. Percutaneous endoscopic gastrostomy (PEG) tubes are the most common type of gastrostomy tubes and are inserted using endoscopic guidance.

4. Jejunostomy Tube (J-Tube): Similar to a gastrostomy tube, a jejunostomy tube is surgically inserted through the abdominal wall into the jejunum (small intestine). Jejunostomy tubes are used when feeding into the stomach is not possible or when bypassing the stomach is necessary due to gastrointestinal issues.

Components of Enteral Nutrition:

Enteral nutrition solutions, also known as tube feeding formulas, are specially formulated to provide a balanced mix of nutrients necessary for maintaining health and supporting healing and recovery.

These formulas typically include the following components:

1. Proteins: Proteins are essential for tissue repair, immune function, and muscle maintenance. Tube feeding formulas contain a combination of amino acids, the building blocks of proteins, which are necessary for various physiological processes.

2. Carbohydrates: Carbohydrates serve as the primary source of energy in tube feeding formulas. They are provided in the form of glucose polymers or simple sugars to meet the patient's energy needs and support metabolic functions.

3. Fats: Lipids are a concentrated source of calories and provide essential fatty acids necessary for cell membrane integrity, hormone synthesis, and nutrient absorption. Tube feeding formulas contain lipid emulsions derived from sources such as soybean oil, olive oil, or medium-chain triglycerides (MCTs).

4. Vitamins and Minerals: Tube feeding formulas are supplemented with vitamins and minerals to prevent nutrient deficiencies and support metabolic functions. These may include water-soluble vitamins (e. g. , B-complex vitamins, vitamin C) and fat-soluble vitamins (e. g. , vitamin A, vitamin D, vitamin E, vitamin K), as well as essential minerals such as calcium, magnesium, potassium, and phosphorus.

5. Water: Tube feeding formulas are typically water-based and provide hydration along with essential nutrients. The water content of the formula is adjusted to meet the patient's fluid needs and prevent dehydration.

Administration of Tube Feeding:

Tube feeding can be administered continuously over a prolonged period using a feeding pump or intermittently in bolus feedings. The method of administration depends on factors such as the patient's clinical condition, nutritional requirements, gastrointestinal function, and feeding tube type.

Continuous feeding involves a slow and steady infusion of the enteral nutrition formula over a specified period, typically 16 to 24 hours per day. Continuous feeding is often preferred for patients who require precise control over nutrient delivery or who have limited gastric tolerance.

Intermittent feeding involves administering larger volumes of the enteral nutrition formula over shorter periods, typically several times a day. Intermittent feeding may be more convenient for patients and caregivers and can help promote appetite and reduce the risk of gastrointestinal complications such as reflux or aspiration.

Tube feeding formulas are administered at a rate and volume prescribed by a healthcare professional based on the patient's nutritional needs, tolerance, and clinical condition. Regular monitoring of tube placement, feeding tolerance, fluid balance, electrolyte levels, and nutritional status is essential to

ensure optimal patient outcomes and prevent complications.

4. 4. 8 Parenteral

Parenteral nutrition (PN) is the intravenous injection (intravenous delivery) of nutrients directly into the systemic circulation, bypassing the digestive tract. A special liquid mixture containing proteins, carbohydrates, fats, vitamins, minerals and other essential nutrients. for life. PN represents an alternative or additional approach to nutritional intervention when oral or enteral routes alone cannot meet nutritional needs or are contraindicated.

Parenteral nutrition is a method of delivering essential nutrients directly into the bloodstream through a catheter placed in a large vein. This approach bypasses the digestive system entirely, making it suitable for individuals who are unable to tolerate oral or enteral feeding due to severe illness, gastrointestinal dysfunction, or other medical conditions. Parenteral nutrition provides all the essential nutrients required for maintaining bodily functions and promoting healing and recovery.

Composition of Nutrients:

Parenteral nutrition solutions are carefully formulated to provide a balanced mix of nutrients tailored to the individual's specific needs. These solutions typically include the following components:

1. **Carbohydrates:** Glucose is the primary source of energy in parenteral nutrition solutions. It is provided in the form of dextrose, which can be adjusted to meet the patient's energy requirements. Carbohydrates are essential for fueling cellular metabolism and supporting various physiological processes.
2. **Proteins:** Amino acids are the building blocks of proteins and are necessary for tissue repair, immune function, and enzyme synthesis. Parenteral nutrition solutions contain a mixture of essential and non-essential amino acids, typically derived from sources such as casein, soy, or crystalline amino acid formulations.
3. **Lipids:** Intravenous lipid emulsions provide essential fatty acids, such as linoleic acid and alpha-linolenic acid, as well as calories for energy. Lipids serve as a concentrated source of energy and help maintain cell membrane integrity, regulate inflammation, and support hormone production. Common lipid sources include soybean oil, olive oil, and medium-chain triglycerides (MCTs).
4. **Electrolytes:** Sodium, potassium, chloride, calcium, magnesium, and phosphate are essential electrolytes that play crucial roles in maintaining fluid balance, nerve function, muscle contraction, and pH balance. Electrolyte concentrations in parenteral nutrition solutions are carefully monitored and adjusted based on the patient's electrolyte status and fluid needs.
5. **Vitamins and Minerals:** Parenteral nutrition solutions are supplemented with vitamins and minerals to prevent nutrient deficiencies and support metabolic functions. These may include water-soluble vitamins (e. g. , B-complex vitamins, vitamin C) and fat-soluble vitamins (e. g. , vitamin A, vitamin D, vitamin E, vitamin K), as well as trace minerals (e. g. , zinc, copper, selenium).
6. **Water:** Parenteral nutrition solutions are diluted with sterile water to provide hydration and maintain fluid balance. The volume of water administered is adjusted based on the patient's fluid requirements, electrolyte status, and clinical condition.

Administration of Parenteral Nutrition:

Parenteral nutrition is typically administered through a central venous catheter, which allows for rapid and efficient delivery of nutrients into the bloodstream. The composition of the parenteral

nutrition solution is carefully monitored and adjusted by healthcare professionals based on the patient's clinical status, nutritional requirements, and laboratory values. Regular monitoring of fluid balance, electrolyte levels, glucose levels, liver function, and renal function is essential to prevent complications such as fluid overload, electrolyte imbalances, hyperglycemia, and hepatic dysfunction.

4.5. LET US SUM UP

Therapeutic nutrition refers to the role of food and nutrition in the treatment of various diseases. This section explains about diet therapy and type of food administration. Types of dietary modifications that are made in the patient's usual diet to meet the patient's medical needs. Here it is learned that all therapeutic diets are the modifications of normal diets.

The purpose of diet modification and different types of diets is being discussed in this section. These include liquid foods, soft foods, and other types of meals. Feeding modes such as oral feeding, tube feeding, peripheral injection feeding and complete feeding parenteral nutrition is well described. Nutritional support is an essential part of medical treatment. As careful awareness and sensitivity are essential for clinical nutritionists to translate nutrition and knowledge into languages appropriate to customer needs. Enough Achieving or maintaining favorable conditions requires knowledge, skills and correct attitude nutritional status.

4.6 CHECK YOUR PROGRESS

Short Questions

1. What is meant by the adaptation of a normal diet?
2. Differentiate between qualitative and quantitative dietary adaptations with an example.
3. Name any two types of therapeutic diets.
4. What are the main modes of feeding?
5. Give an example of a condition requiring quantitative dietary adaptation.

Long Questions

1. Explain the importance of qualitative and quantitative adaptations in modifying a normal diet.
2. Describe the different types of diets used in therapeutic nutrition with examples.
3. Discuss the modes of feeding and their relevance in different clinical conditions.
4. How can a normal diet be adapted to meet the nutritional needs of a diabetic patient?
5. Illustrate the process of designing a diet plan for a patient requiring enteral nutrition

BLOCK-2 : NUTRITION DURING LIFE CYCLE

INTRODUCTION

Nutrition during the life cycle involves tailoring dietary needs to various stages of life, from infancy to childhood, adolescence, adulthood, and into old age. It addresses changing nutrient requirements, growth, development, and age-related health concerns. Key considerations include providing essential nutrients for growth and development in early life, ensuring balanced nutrition for optimal health in adulthood, and addressing nutrient absorption and dietary adjustments to support aging individuals' well-being. Nutrition during the life cycle refers to the practice of adapting dietary intake and nutritional needs to meet the specific requirements of individuals at different stages of life. This concept recognizes that nutritional needs change from infancy through childhood, adolescence, adulthood, and into old age. Overall, nutrition during the life cycle aims to support growth, prevent health issues, and promote overall well-being at each stage, recognizing that individual nutritional needs may vary based on factors like genetics, lifestyle, and health conditions.

Unit-5: Nutrition in pregnancy and lactation involves adapting dietary plans to meet the unique needs of individuals with specific health conditions or circumstances. This can include managing diabetes, addressing food allergies, supporting athletes' performance, addressing malnutrition, and providing nutritional care for individuals. The goal is to optimize nutrient intake and dietary choices to improve health outcomes and quality of life in these particular situations. Nutrition during pregnancy and lactation aims to provide essential nutrients for maternal health, fetal growth, and breastfeeding. Adequate calorie and nutrient intake are crucial, with increased requirements for folic acid, iron, calcium, and protein. Diet patterns should emphasize a balanced intake of whole grains, lean proteins, fruits, and vegetables. Feeding patterns involve regular, small, nutrient-rich meals. Factors influencing diet plan include individual health, weight gain goals, and any pregnancy-related complications. Lactation physiology involves hormonal changes that promote milk production, requiring additional calories and fluids. It's essential to avoid food fads and focus on a well-rounded diet to meet these nutritional needs during pregnancy and lactation adequately.

Unit-6: Nutrition during infancy and childhood is crucial for growth and development. Infants are typically breastfed or formula-fed with a focus on breast milk or infant formula for essential nutrients. Around 6 months, the introduction of solid foods begins, starting with single-ingredient, easily digestible foods. As children grow, a balanced diet rich in nutrients like protein, iron, calcium, and vitamins is vital. Proper nutrition supports physical and cognitive development, builds a strong immune system, and lays the foundation for lifelong healthy eating habits. It's essential for parents and caregivers to provide a variety of nutrient-dense foods, monitor growth and development, and encourage healthy eating patterns during these critical early years.

Unit-7: Nutrition during adolescence and adulthood focuses on meeting increased energy and nutrient demands for growth and development, emphasizing calcium, iron, and protein intake. Adulthood nutrition aims to maintain a balanced diet to support overall health, with considerations for pregnancy and aging. In old age, attention shifts to managing chronic conditions, maintaining muscle mass, and addressing potential nutrient deficiencies, often requiring a focus on vitamin D, calcium, and vitamin B12 intake. Nutrition plays a pivotal role in promoting well-being and preventing age-related health issues at each life stage.

Unit-8: Nutrition during weight management involves controlling calorie intake and promoting a balanced diet to achieve and maintain a healthy weight. The objective is to create a calorie deficit

through a combination of reduced calorie consumption and increased physical activity. Nutrient-dense foods, portion control, and mindful eating are key strategies. Balanced macronutrient intake, fiber-rich foods, and lean proteins help support satiety and maintain muscle mass. Effective weight management also considers individual preferences, cultural factors, and sustainable lifestyle changes to achieve long-term success in maintaining a healthy weight.

UNIT-5 : NUTRITION IN PREGNANCY AND LACTATION

Structure

- 5. 1. Introduction
 - 5. 1. 1 Needs and Objectives
 - 5. 1. 2 Nutrient Requirement
 - 5. 1. 3 Diet Pattern during Pregnancy
 - 5. 1. 4 Feeding Pattern
 - 5. 1. 5 Factors Affecting Diet Planning During Pregnancy
 - 5. 1. 6 Food Fads
 - 5. 1. 7 Myths
 - 5. 1. 8 Nutritional Problems during Pregnancy
- 5. 2. Lactation
 - 5. 2. 1 Exclusive Breastfeeding
 - 5.2.2 Nutritional Requirements for Lactating Mothers
 - 5.2.3 Dietary Concerns for Lactating Mother
 - 5.2.4 Feeding Pattern for Lactating Mother
 - 5.2.5 The Let-Down Reflex
 - 5.2.6 Myths Related to Lactation
 - 5.2.7 Fads Related to Lactation
 - 5.2.8 Physiology of Lactation
 - 5.2.9 Breastfeeding Positions and Guidelines for Mothers
 - 5.2.10 Breastfeeding Complications and their Possible Solutions
 - 5.2.11 Benefits of Breastfeeding over Bottle Feeding
- 5.3. Let Us Sum Up
 - 5.3.1 Check Your Progress

5. 1. INTRODUCTION

Since, time immemorial it has been realized that the pregnant women and lactating mother are constituting one of the most important vulnerable sections of the society. The poor nutritional status and inadequate diet of mother impacts not only the mother but also the offspring. So, it is very vital to know the nutritional needs of the pregnancy and dietary requisites of the lactation period.

Section-A explains the nutritional needs, objectives and dietary requirements of pregnancy, the ideal diet and feeding pattern of pregnant women, factors influencing the diet planning during pregnancy and food fads during the pregnancy.

Pregnancy is a time of increased nutritional needs for the women. A good health of a woman is essential for the growing foetus and later on for a healthy baby. The successful pregnancy is the outcome of the pregnancy triad i. e, following a balanced diet coupled with a proper exercise regime

and prenatal care. These reduce the chances of complications during pregnancy, birth defects and also ensures the healthy brain development, ideal birth weight, and health outcomes in future years of a baby. A healthy balanced diet also minimizes the chances of micro-nutrient deficiency disorders among both mother and infant.

Nutrition plays a vital role during pregnancy, as it directly affects the health and development of both the mother and the growing foetus. The role of nutrition during pregnancy can be further detailed as follows:

1. 1 Overall Nutritional Needs: During pregnancy, the body's nutritional requirements increase to support maternal physiological changes along with foetal growth and development. Adequate intake of macronutrients (carbohydrates, proteins, and fats) and micronutrients (vitamins and minerals) is essential.

1. 1. i) Folate/Folic Acid: Adequate folate intake before and during early pregnancy is important for the prevention of neural tube defects (NTDs) in the developing foetus. Good sources of folate include leafy green vegetables, citrus fruits, beans, lentils, and fortified cereals.

1. 1. ii) Iron: Iron requirements increase during pregnancy to support the expansion of maternal red blood cell mass and foetal development. Insufficient iron intake can lead to iron-deficiency anaemia in the mother and increase the risk of preterm birth and low birth weight.

Good sources of iron include lean meats, poultry, fish, legumes, fortified cereals, and leafy green vegetables.

1. 1. iii) Calcium and Vitamin D: Calcium and vitamin D are essential for the development of the bones and teeth. Adequate calcium intake during pregnancy is important for the prevention of maternal bone loss. Good sources of calcium include dairy products, fortified plant-based milk alternatives, leafy green vegetables, and tofu.

Vitamin D can be obtained through exposure to sunlight and dietary sources such as fatty fish and fortified dairy products.

1. 1. iv) Omega-3 Fatty Acids: Omega-3 fatty acids, particularly DHA (docosahexaenoic acid), play a crucial role in foetal brain and eye development. Good sources of omega-3 fatty acids include fatty fish (e. g. , salmon, sardines), walnuts, chia seeds, and flaxseeds.

1. 1. v) Protein: Adequate protein intake is important for the growth and development of the baby. Sources include lean meats, poultry, fish, eggs, dairy products, legumes, nuts, and seeds.

1. 1. vi) Fiber: Consuming an adequate amount of dietary fibre can help prevent constipation, a common issue during pregnancy. It includes whole grains, fruits, vegetables, legumes, and nuts.

1. 1. vii) Hydration: Staying properly hydrated is essential during pregnancy. Aim to drink plenty of water and other fluids throughout the day to support overall health and prevent dehydration.

1. 2 Weight Management: Proper nutrition plays a role in maintaining a healthy weight during pregnancy. Aim for appropriate weight gain according to healthcare provider's recommendations to support the baby's growth and reduce the risk of complications.

1. 3 Avoiding Harmful Substances: During pregnancy, it is crucial to avoid harmful substances such as alcohol, tobacco, and illicit drugs. Limit caffeine intake as excessive amounts may have adverse effects on pregnancy.

Remember, each pregnancy is unique, and nutritional needs may vary. It is essential to work closely with healthcare professionals, including doctors and registered dietitians, to develop a personalized nutrition plan that meets your specific needs and addresses any underlying medical conditions or

concerns.

5. 1. 1 NEEDS AND OBJECTIVES:

The pregnant women need a well-balanced nutritious diet, adequate quantity of rest & sleep during the last trimester, proper immunisation, iron and folic acid supplements throughout the gestational period.

The needs and objectives of pregnancy refer to the requirements and goals that are important to ensure a healthy and successful pregnancy for both the mother and the developing baby. These needs and objectives can be summarized as follows:

2. 1 Nutritional Needs: During pregnancy, the mother's body has increased nutritional requirements to support the growth and development of the foetus. A balanced and nutrient-rich diet is necessary to provide essential vitamins, minerals, protein, carbohydrates, and healthy fats.

2. 2 Adequate Weight Gain: Healthy weight gain during pregnancy is important to support the growth of the baby and ensure proper development. The appropriate amount of weight gain depends on the factors such as pre-pregnancy weight, overall health, and individual circumstances.

2. 3 Regular Prenatal Care: Regular prenatal check-ups with healthcare providers are crucial to monitor the progress of the pregnancy, detect any potential complications or risks, and ensure the well-being of both the mother and the baby. These appointments typically include physical examinations, ultrasounds, and various tests.

2. 4 Exercise and Physical Activity: Engaging in regular, moderate-intensity exercise, as advised by a healthcare provider, can help maintain overall fitness, manage weight gain, boost mood, and promote better sleep. However, it is essential to follow appropriate exercise guidelines for pregnancy and avoid high-impact or risky activities.

2. 5 Emotional and Mental Well-being: Pregnancy can bring about various emotional and psychological changes. It is important for expectant mothers to prioritize their emotional well-being, seek support from their partner, family, or professionals, and engage in activities that promote relaxation, stress management, and self-care.

2. 6 Education and Preparation: Learning about pregnancy, childbirth, and parenting through reputable sources or prenatal education classes can help expectant parents feel more confident and prepared. Understanding the changes that occur during pregnancy and the stages of labour and delivery can contribute to a positive birthing experience.

2. 7 Managing Discomfort and Symptoms: Pregnancy can be accompanied by discomfort and common symptoms such as nausea, fatigue, back pain, and swelling. Implementing strategies to alleviate these symptoms, such as maintaining good posture, getting sufficient rest, practicing relaxation techniques, and seeking appropriate medical advice, can improve comfort levels.

2. 8 Preparing for Labor and Delivery: As the due date approaches, expectant parents may set goals and preferences for the birthing experience. This can include discussing birth plans, exploring pain management options, choosing a healthcare provider or birth setting, and understanding the signs of labour.

2. 9 Ensuring a Safe Environment: Creating a safe and supportive environment for the mother and the baby is crucial. This involves avoiding exposure to harmful substances (such as tobacco smoke, alcohol, and certain medications), maintaining good hygiene practices, and taking necessary precautions to prevent accidents or injuries.

2. 10 Bonding and Emotional Connection: Building a bond with the baby during pregnancy is

important for both the mother and baby's well-being. Engaging in activities such as talking to the baby, playing music, or gently massaging the belly can foster emotional connection and promote a sense of closeness.

It is essential for expectant mothers to consult with healthcare professionals, such as obstetricians, midwives, or doulas, to receive personalized guidance and support throughout their pregnancy journey.

5. 1. 2 NUTRIENT REQUIREMENT:

During pregnancy, a woman's nutritional needs increase to support the growth and development of the foetus, as well as to maintain overall health.

Table 5: SUMMARY OF RDA-2020 FOR INDIANS WOMEN, PREGNANT AND LACTATING

Age Group	Category of work	Body Wt	Protein	CHO	Cal cium	Magne sium	Iron	Zinc	Iodine	Thiamine	Ribo flavin	Niacin	Vit B6	Folate	Vit B12	Vit C	Vit A	Vit D
		(kg)	(g/d)	(g/d)	(mg/ d)	(mg /d)	(mg/ d)	(mg /d)	(µg/ day)	(mg /d)	(mg /d)	(mg /d)	(mg/ d)	(µg /d)	(µg/ d)	(mg/ d)	(µg/ d)	(IU/ d)
Women	Sedentary	55	45.7	130	1000	325	29	13.2	150	1.4	1.9	11	1.9	220	2.5	65	840	600
	Moderate									1.7	2.4	14	1.9					
	Heavy									2.2	3.1	18	2.4					
	Pregnant woman	55 + 10	+9.5 (2 nd trimester) +22.0 (3 rd trimester)	175	1000	385	40	14.5	250	2.0	2.7	+2.5	2.3	570	+0.25	+15	900	600
	Lactation 0-6m		+16.9	200	1200	325	23	14	280	2.1	3.0	+5	+0.26	330	+1.0	+50	950	600
	7-12m		+13.2	200						2.1	2.9	+5	+0.17	330				

Nutritional needs during pregnancy in detail:

3. 1 Calories: Caloric intake during pregnancy should be increased to support the energy needs of both mother and the growing foetus. The exact amount depends on factors such as pre-pregnancy weight, activity level, and trimester. On average, an additional 350 calories per day are recommended.

3. 2 Protein: Protein is essential for the development of foetal tissues and organs. Pregnant women should aim to consume about 75-100 grams of protein per day. Proteins helps to supply the much-needed amino acids which are the building blocks of the cells of the body both for the mother and baby. Good sources of protein include lean meats, poultry, fish, eggs, dairy products, legumes, nuts, and seeds.

3. 3 Carbohydrates: Carbohydrates are a crucial source of energy and provide essential nutrients and fibre. Complex carbohydrates, such as whole grains, fruits, vegetables, and legumes, are preferred over simple carbohydrates like refined sugars, processed foods made from refined flours, excess sugars, fruit juices and confectionary items.

3. 4 Fats: Healthy fats are important for the development of the baby's brain and nervous system. Unsaturated fats, such as those found in avocados, nuts, seeds, and vegetable oils, are preferable to saturated fats. Omega-3 fatty acids, found in fatty fish (like salmon), walnuts, and flaxseeds, are particularly beneficial.

3. 5 Iron: Iron is needed to support the increased blood volume during pregnancy and to prevent maternal anaemia. Good sources of iron include lean red meat, poultry, fish, legumes, fortified cereals, and dark leafy greens. Consuming vitamin C-rich foods along with iron-rich foods helps with iron absorption.

3. 6 Folate: Folate (or folic acid, the synthetic form) is vital for preventing neural tube defects in the developing foetus. Pregnant women should consume foods rich in folate, such as leafy green vegetables, citrus fruits, beans, peas, and fortified cereals. Prenatal supplements often contain folic

acid as well.

3. 7 Calcium: Calcium is essential for the development of the baby's bones and teeth. Good sources of calcium include dairy products, fortified plant-based milk alternatives, tofu, almonds, leafy greens, and calcium-fortified foods.

3. 8 Vitamin D: Vitamin D helps the body to absorb calcium and is important for bone health. Exposure to sunlight, fortified dairy products, fatty fish, and some fortified foods (milk and cereals) can help meet the vitamin D needs. In some cases, a supplement may be necessary. Most prenatal vitamins have around 400 IU of vitamin D.

3. 9 Vitamin B12: Vitamin B12 is crucial for the formation of red blood cells and the development of the baby's nervous system. It is found primarily in animal products, so vegetarians and vegans should consider B12 supplements or fortified foods.

3. 10 Fluids: Staying well-hydrated is essential during pregnancy. Drinking plenty of water helps support the increased blood volume, prevents constipation, and aids in the digestion and absorption of nutrients.

It is important for pregnant women to consult with their healthcare provider or a registered dietitian to determine their specific nutritional needs, as individual requirements may vary. They can provide personalized recommendations based on factors such as age, weight, overall health, and any specific dietary restrictions or conditions.

5. 1. 3 DIET PATTERN DURING PREGNANCY:

During pregnancy, it is important to follow a balanced and nutritious diet to support the health and development of both the mother and the baby. The following is an example of an appropriate diet pattern during pregnancy:

4. 1 Whole Grains: Include a variety of whole grains such as brown rice, quinoa, oats, whole wheat bread, and whole grain cereals. These provide complex carbohydrates, fibre, and essential nutrients.

4. 2 Fruits and Vegetables: Diet of a pregnant lady should aim for a colourful array of fruits and vegetables to ensure a good intake of vitamins, minerals, and antioxidants. Include leafy greens, citrus fruits, berries, bell peppers, broccoli, carrots, and sweet potatoes.

4. 3 Protein Sources: Consume lean sources of protein such as poultry, fish, lean meats, eggs, legumes, tofu, and dairy products (if not lactose intolerant or following a vegan diet). These provide essential amino acids for foetal growth and development.

4. 4 Healthy Fats: Incorporate sources of healthy fats, including avocados, nuts, seeds, olive oil, and fatty fish (like salmon or sardines). These provide omega-3 fatty acids, which are crucial for the baby's brain and eye development.

4. 5 Dairy or Alternatives: Include dairy products like milk, yogurt, and cheese, or opt for fortified plant-based milk alternatives if you follow a vegan or lactose-free diet. These are rich in calcium, vitamin D, and protein.

4. 6 Legumes and Beans: Legumes such as lentils, chickpeas, black beans, and kidney beans are excellent sources of plant-based protein, fibre, iron, and folate. Include them in soups, stews, salads, or as a side dish.

4. 7 Hydration: Drink plenty of water throughout the day to stay hydrated. Aim for around 8-10 cups (2-2.5 litres) of fluids daily. Water is essential for maintaining bodily functions and supports the increased blood volume during pregnancy.

Snacks: Opt for healthy snacks such as fresh fruit, yogurt, nuts, seeds, whole grain crackers with

hummus, or vegetable sticks with a nutritious dip.

Limit Processed Foods: Minimize the consumption of processed and packaged foods that are high in added sugars, unhealthy fats, and sodium. These offer limited nutritional value and may contribute to excessive weight gain.

Prenatal Supplements: Take a prenatal vitamin and mineral supplement as prescribed by your healthcare provider. These supplements help bridge any nutritional gaps and ensure adequate intake of essential nutrients like folic acid and iron.

Remember, every pregnancy is unique, and individual dietary needs may vary. It is crucial to consult with a healthcare provider or a registered dietitian for personalized advice and to address any specific dietary concerns or conditions needed during pregnancy.

5. 1. 4 FEEDING PATTERN:

When it comes to feeding patterns during pregnancy, it's important to focus on a balanced and nutritious diet to meet the increased nutritional needs of both the mother and the developing baby. Here are some guidelines for a healthy feeding pattern during pregnancy:

5. 1 Regular Meals: Aim to have three balanced meals each day, including breakfast, lunch, and dinner. This helps to ensure a steady supply of nutrients throughout the day and prevents excessive hunger or overeating.

5. 2 Nutrient-Dense Foods: Choose nutrient-dense foods that provide essential vitamins, minerals, protein, carbohydrates, and healthy fats. Include a variety of fruits, vegetables, whole grains, lean proteins, dairy products (or alternatives), and healthy fats in your meals.

5. 3 Snacks: Incorporate healthy snacks between meals to help maintain energy levels and prevent hunger. Go for nutritious options like fresh fruit, yogurt, nuts, seeds, whole grain crackers with hummus, or vegetable sticks with a nutritious dip.

5. 4 Hydration: Drink plenty of fluids throughout the day, aiming for around 8-10 cups (2-2.5 litres) of water. Staying well-hydrated supports the increased blood volume during pregnancy and helps prevent constipation.

5. 5 Balanced Macronutrients: Include a balance of macronutrients in each meal. Aim for a combination of carbohydrates (from whole grains, fruits, and vegetables), proteins (from lean meats, poultry, fish, legumes, and dairy products), and healthy fats (from avocados, nuts, seeds, and oils).

5. 6 Fiber-Rich Foods: Include fibre-rich foods like whole grains, fruits, vegetables, legumes, and nuts to help prevent constipation, which is a common issue during pregnancy.

5. 7 Iron-Rich Foods: Consume iron-rich foods to support the increased blood volume and prevent iron deficiency anaemia. Good sources include lean meats, poultry, fish, legumes, fortified cereals, and dark leafy greens. Combining iron-rich foods with vitamin C-rich foods enhances iron absorption.

5. 8 Calcium Sources: Include calcium-rich foods like dairy products (or alternatives), leafy greens, fortified plant-based milk alternatives, and calcium-fortified foods. Calcium is essential for the baby's bone development.

5. 9 Healthy Cooking Methods: Opt for healthy cooking methods such as steaming, baking, grilling, or sautéing instead of deep-frying. This helps in retaining the nutritional value of the food and reduces the intake of excess unhealthy fats.

5. 10 Prenatal Supplements: Take a prenatal vitamin and mineral supplement as prescribed by healthcare provider. These supplements help to ensure adequate intake of essential nutrients like folic

acid, iron, and calcium.

Remember to consult with your healthcare provider or a registered dietitian for personalized advice and recommendations based on specific nutritional needs and any individual dietary considerations or restrictions that can be followed during pregnancy

5. 1. 5 FACTORS AFFECTING DIET PLANNING DURING PREGNANCY:

Several factors can influence diet planning during pregnancy. It's important to consider these factors to ensure that diet meets the specific needs of the mother and supports the healthy development of the baby. Here are some key factors that can affect diet planning during pregnancy:

6. 1 Pre-existing Health Conditions: Certain pre-existing health conditions, such as diabetes, gestational diabetes, high blood pressure, or food allergies, can impact dietary choices during pregnancy. It's crucial to work with healthcare providers or registered dietitians to develop a specialized meal plan that addresses these conditions.

6. 2 Weight and Body Mass Index (BMI): The pre-pregnancy weight and BMI of the mother play a role in determining the appropriate weight gain goals and nutritional needs during pregnancy. Women with higher BMI may require specific dietary considerations to manage weight gain and prevent complications.

6. 3 Multiple Pregnancies: In the case of carrying twins, triplets, or more, the nutritional needs are typically higher compared to a singleton pregnancy. Extra calories, protein, and nutrients may be required. Healthcare providers or dietitians can provide guidance on meeting these increased needs.

6. 4 Morning Sickness or Food Aversions: Nausea and vomiting, commonly known as morning sickness, can significantly affect the food intake and choices during early pregnancy. Strong food aversions may also limit the variety of foods that can be consumed. In such cases, finding tolerated foods and exploring alternative options becomes important to ensure adequate nutrition.

6. 5 Cultural and Personal Food Preferences: Cultural and personal food preferences play a significant role in dietary choices. Pregnancy diet planning should consider incorporating foods that are culturally appropriate and enjoyable for the mother while still meeting nutritional requirements.

6. 6 Vegetarian or Vegan Diets: Women following vegetarian or vegan diets during pregnancy need to pay attention to adequate protein, iron, calcium, vitamin B12, and omega-3 fatty acid intake. Consulting a healthcare provider or dietitian can help to ensure that need of appropriate food choices or supplements.

6. 7 Food Safety: Pregnancy increases susceptibility to foodborne illnesses, which can pose risks to both the mother and the baby. It is crucial to follow food safety guidelines, such as avoiding raw or undercooked meats, eggs, and seafood, and consuming pasteurized dairy products. Also, certain foods like unpasteurized cheeses, raw sprouts, and high-mercury fish should be avoided or limited.

6. 8 Financial Considerations: Financial constraints may affect food choices during pregnancy. Planning meals that incorporate affordable nutrient-rich foods and considering local resources, such as food assistance programs or community support, can help address these challenges.

6. 9 Lifestyle and Activity Level: The mother's lifestyle and activity level impact energy requirements and nutritional needs. For instance, physically demanding jobs or regular exercise may require adjustments in caloric intake and nutrient timing.

6. 10 Personalized Recommendations: Each pregnancy is unique, and individual nutritional needs may vary. Personalized recommendations from healthcare providers, such as obstetricians, midwives, or registered dietitians, should be considered to address specific health concerns or

circumstances.

Considering these factors and working closely with healthcare providers or registered dietitians can help develop a customized and appropriate diet plan that optimizes nutrition and supports a healthy pregnancy.

5. 1. 6 FOOD FADS

During pregnancy, it's common for various food fads or trends to emerge. While some may have merit, it's important to approach them with caution and consider their impact on overall nutrition and safety. Here are a few food fads during pregnancy:

7. 1 Raw or Undercooked Foods: Raw or undercooked foods, such as sushi, unpasteurized cheeses, raw eggs, and raw sprouts, are often advised against during pregnancy due to the risk of foodborne illnesses like salmonella or listeria. It's crucial to prioritize food safety and opt for properly cooked and pasteurized foods.

7. 2 Excessive Restriction or Elimination Diets: Some pregnant women may consider following restrictive diets, such as cutting out entire food groups or following extreme weight-loss plans. However, these practices can potentially lead to nutrient deficiencies and compromise the baby's growth and development. It's important to maintain a balanced and varied diet unless advised by a healthcare professional.

7. 3 Superfoods and Supplements: Superfoods, which are often marketed as nutrient powerhouses, may gain popularity during pregnancy. While incorporating nutrient-rich foods like berries, leafy greens, and nuts is beneficial, it's important to remember that no single food can provide all the necessary nutrients. Relying solely on superfoods or excessive supplementation without medical guidance is unnecessary and can be risky.

7. 4 Herbal Supplements and Remedies: Some herbal supplements or remedies may be promoted as natural remedies for various pregnancy-related issues. However, many herbs and herbal products have not been thoroughly researched for their safety during pregnancy. Some herbs may have adverse effects or interactions with medications. It's essential to consult with a healthcare provider before using any herbal supplements or remedies.

7. 5 Excessive Caffeine Consumption: While moderate caffeine intake (up to 200 mg per day) is generally considered safe during pregnancy, excessive caffeine consumption should be avoided. High levels of caffeine can increase the risk of miscarriage, preterm birth, and low birth weight. It's important to be mindful of caffeine content in coffee, tea, chocolate, and certain beverages.

7. 6 Juice Cleanses or Detox Diets: Juice cleanses or detox diets involve consuming only fruit or vegetable juices for a specific period. These practices are not recommended during pregnancy as they may not provide adequate nutrients and calories needed for both the mother and baby. It's essential to focus on a balanced and varied diet to ensure proper nutrition.

Remember, it's always best to consult with a healthcare provider or a registered dietitian for personalized advice during pregnancy. They can provide evidence-based recommendations and guidance tailored to individual needs and circumstances, helping to ensure a safe and healthy pregnancy.

5. 1. 7 MYTHS:

During pregnancy, several food myths and misconceptions circulate. It's important to separate fact from fiction to make informed choices about diet and nutrition. Here are some common food myths

during pregnancy:

8. 1 "You're eating for two": This myth suggests that pregnant women need to consume double the amount of food. In reality, the calorie needs during pregnancy increase, but the increase is not double. The focus should be on nutrient-dense foods rather than excessive portions.

8. 2 "Avoid seafood completely": While certain high-mercury fish should be limited during pregnancy, many types of seafood are safe and offer important nutrients like omega-3 fatty acids. It's recommended to choose low-mercury options like salmon, shrimp, and canned light tuna.

8. 3 "Pregnant women should avoid all cheeses": Not all cheeses are off-limits during pregnancy. Hard cheeses like cheddar, swiss, and pasteurized versions of soft cheeses like mozzarella and cottage cheese are generally safe to consume. However, unpasteurized or mould-ripened soft cheeses should be avoided due to the risk of listeria.

8. 4 "Spicy foods can harm the baby": Spicy foods are safe to consume during pregnancy and do not harm the baby. However, they may cause discomfort or heartburn for some pregnant women. Moderation and listening to your body's preferences are key.

8. 5 "Eating pineapple can cause miscarriage": Pineapple contains an enzyme called bromelain, which in large amounts may have a mild effect on softening the cervix. However, the amount of bromelain in a normal serving of pineapple is unlikely to cause any adverse effects or induce miscarriage.

8. 6 "Avoid all caffeine": While high levels of caffeine should be limited, moderate caffeine intake (up to 200 mg per day) is generally considered safe during pregnancy. It's important to be mindful of caffeine content in coffee, tea, chocolate, and certain beverages, but complete avoidance is unnecessary.

8. 7 "You must eat for cravings": While it's okay to indulge in cravings occasionally, it's important to maintain a balanced diet overall. Cravings are not necessarily an indication of nutritional deficiencies, but rather a normal part of pregnancy for many women.

8. 8 "You can't eat deli meats or hot dogs": While it's advisable to avoid unpasteurized or undercooked deli meats and hot dogs due to the risk of listeria, properly cooked and heated versions are safe to consume.

8. 9 "Pregnant women should avoid exercise and physical activity": Moderate exercise and physical activity are generally beneficial and safe during pregnancy. Of course, it's important to consult with a healthcare provider and follow appropriate guidelines and precautions for exercise during pregnancy.

8. 10 "Eating spicy foods will induce labor": Spicy foods may cause temporary discomfort or heartburn, but there is no substantial evidence to suggest that they induce labor or bring on contractions.

5. 1. 9. NUTRITIONAL PROBLEMS DURING PREGNANCY

Nutritional problems during pregnancy can have significant implications for both the mother and the developing foetus. Adequate nutrition is crucial to support the growth and development of the baby, as well as to maintain the health and well-being of the mother. Here are detailed notes on common nutritional problems during pregnancy:

9. 1 Gestational Diabetes: Gestational diabetes is a form of diabetes that develops during pregnancy. It occurs when the body cannot produce enough insulin to meet the increased demands of pregnancy, leading to high blood sugar levels. Poorly controlled gestational diabetes can result in

complications for both the mother and the baby. It is essential to manage blood sugar levels through a balanced diet, regular physical activity, and, in some cases, medication.

9. 2 Iron Deficiency Anemia: Iron deficiency anemia is common during pregnancy due to the increased demand of iron to support the fetal growth and development. Inadequate iron intake or poor iron absorption can lead to low iron levels in the blood, resulting in fatigue, weakness, and impaired immune function. Iron-rich foods, such as lean meats, poultry, fish, legumes, and leafy green vegetables, along with iron supplementation, may be recommended to prevent or treat anemia.

9. 3 Folate Deficiency: Folate, also known as folic acid, is essential for the development of the baby's neural tube, which forms the brain and spinal cord. Inadequate folate intake during pregnancy increases the risk of neural tube defects in the baby. Pregnant women are advised to consume foods rich in folate, such as leafy green vegetables, citrus fruits, legumes, and fortified grains, or a folic acid supplement as recommended by healthcare professionals.

9. 4 Inadequate Weight Gain: Inadequate weight gain during pregnancy can result from insufficient calorie intake or excessive physical activity. It can lead to complications, including low birth weight, preterm birth, and developmental issues for the baby. Healthcare providers monitor weight gain during pregnancy and provide guidance on appropriate calorie intake to support healthy foetal growth.

9. 5 Excessive Weight Gain: Excessive weight gain during pregnancy increases the risk of complications for both the mother and the baby. It can contribute to gestational diabetes, high blood pressure, and an increased likelihood of delivering a large baby, which may require a caesarean section. Healthcare providers advise pregnant women on appropriate weight gain ranges based on their pre-pregnancy body mass index (BMI) and individual circumstances.

9. 6 Nutrient Deficiencies: Pregnant women may experience deficiencies in various nutrients, including calcium, vitamin D, omega-3 fatty acids, and iodine. These nutrients play crucial roles in the development of the baby's bones, nervous system, and overall growth. A balanced diet that includes dairy products, fortified foods, fatty fish, and prenatal supplements can help meet the increased nutrient requirements during pregnancy.

9. 7 Foodborne Illness: Pregnant women are more susceptible to foodborne illnesses due to changes in their immune system. Infections such as listeriosis and toxoplasmosis can pose risks to the developing foetus. Pregnant women should practice food safety measures, such as proper storage, handling, and cooking of foods, and avoid high-risk foods like unpasteurized dairy products and undercooked meats.

9. 8 Nausea and Vomiting: Nausea and vomiting, commonly known as morning sickness, can affect pregnant women, particularly during the first trimester. Severe and prolonged nausea and vomiting, known as hyperemesis gravidarum, can lead to dehydration and inadequate nutrient intake. It is important to manage symptoms by eating small, frequent meals, staying hydrated, and seeking medical advice if symptoms are severe or persistent.

9. 9 Pica: Pica is a condition characterized by cravings for non-food substances, such as dirt, clay, or ice, which can be nutritionally deficient or harmful. Pica can interfere with the intake of nutritious foods and increase the risk of nutrient deficiencies and complications during pregnancy. Addressing pica requires a multidisciplinary approach involving healthcare providers, nutrition counseling, and addressing underlying causes or deficiencies.

9. 10 Poor Diet Quality: Some pregnant women may have poor diet quality, consuming excessive amounts of processed foods high in sugar, unhealthy fats, and low in essential nutrients. Poor diet quality can lead to inadequate intake of important nutrients and increased risk of gestational

diabetes, excessive weight gain, and other complications. Encouraging a balanced diet rich in whole grains, lean proteins, fruits, vegetables, and healthy fats is essential for a healthy pregnancy.

It's important for pregnant women to work closely with their healthcare providers, including obstetricians and registered dietitians, to address any nutritional problems during pregnancy. Individualized dietary recommendations and appropriate prenatal supplements can help ensure optimal nutrition for both the mother and the developing baby.

5.2.0 LACTATION

5. 2. 1 EXCLUSIVE BREASTFEEDING

1. 1 Definition: Exclusive breastfeeding means providing only breast milk to the baby, without any other liquids or solid foods, including water, for the first six months of life.

1. 2 Benefits: Exclusive breastfeeding offers numerous benefits to both baby and the mother. For the baby, it provides complete nutrition, protects against infections and diseases, supports optimal growth and development, and promotes bonding and emotional connection. For the mother, it helps with postpartum recovery, promotes weight loss, reduces the risk of certain cancers, and enhances the bond with baby.

1. 3 Nutritional Composition of breastmilk: Breast milk is uniquely designed to meet the nutritional needs of infants. It contains the perfect balance of carbohydrates, proteins, fats, vitamins, minerals, and antibodies to support healthy growth and development.

Breast milk is a complex and dynamic fluid that provides optimal nutrition and immune protection for infants. Its composition changes throughout the stages of lactation and adapts to the specific needs of the growing baby. Following is the composition of breast milk:

1. 3. i) Macronutrients:

1. 3. i. a) Carbohydrates: The primary carbohydrate in breast milk is lactose, which provides energy to the baby. Lactose also aids in calcium absorption.

1. 3. i. b) Proteins: Breast milk contains a variety of proteins, including whey proteins (easily digested) and casein proteins (providing a slower release of amino acids). These proteins contribute to growth and development.

1. 3. i. c) Fats: Breast milk contains a balance of essential fatty acids, cholesterol, and fat-soluble vitamins. Fats provide energy, support brain development, and aid in the absorption of fat-soluble vitamins.

1. 3. ii) Micronutrients:

1. 3. ii. a) Vitamins: Breast milk provides a wide range of vitamins, including vitamin A, vitamin D, vitamin E, vitamin K, and various B vitamins.

1. 3. ii. b) Minerals: Breast milk contains minerals such as calcium, iron, zinc, magnesium, phosphorus, sodium, and potassium. These minerals support bone development, enzyme function, and overall growth.

1. 3. iii) Immunological Components:

1. 3. iii. a) Secretory Immunoglobulin A (IgA): Breast milk is rich in secretory IgA, which provides immune protection against infections and helps prevent pathogens from attaching to the baby's mucous membranes.

1. 3. iii. b) White Blood Cells: Breast milk contains various types of white blood cells, including lymphocytes and macrophages, which help defend against infections.

1. 3. iii. c) Other Immune Factors: Breast milk contains cytokines, growth factors, and other bioactive components that support the baby's immune system.

1. 3. iv) Enzymes and Hormones: Breast milk contains enzymes and hormones that aid in digestion, nutrient absorption, and metabolic processes in the baby's body.

1. 3. v) Prebiotics and Probiotics: Breast milk contains prebiotics, such as human milk oligosaccharides (HMOs), which act as food for beneficial gut bacteria in the baby's intestines. These promote a healthy gut microbiome and support the development of the immune system.

1. 3. vi) Water: Breast milk is composed mostly of water, providing hydration to the baby. The water content of breast milk adjusts to meet the baby's hydration needs.

It's important to note that the composition of breast milk can vary between individuals and throughout the course of lactation. Factors such as maternal diet, health status, and environmental conditions can influence the specific composition of breast milk. Additionally, breast milk changes in volume and composition to meet the changing needs of the growing infant as they develop.

1. 4 Establishing Exclusive Breastfeeding: Initiate breastfeeding as soon as possible after birth, ideally within the first hour.

Practice skin-to-skin contact with your baby, which promotes bonding and helps stimulate breastfeeding. Offer the breast frequently, at least 8-12 times in 24 hours, following your baby's hunger cues. Ensure a proper latch and comfortable breastfeeding positions to facilitate effective milk transfer.

1. 5 Feeding on Demand: Breastfeed baby whenever they show signs of hunger, such as rooting, sucking on fists, or increased alertness. Avoid strict schedules and instead focus on responsive feeding, allowing your baby to determine the frequency and duration of feedings.

1. 6 Benefits of "Cluster Feeding": Cluster feeding refers to periods when babies want to nurse more frequently, often close together in time. Cluster feeding is a normal behaviour and helps establish and regulate milk supply while meeting your baby's growth spurt needs.

1. 7 Avoiding Supplementation: Exclusive breastfeeding means not giving any other liquids or solid foods to your baby, including water, formula, or pacifiers, for the first six months. This ensures that your baby receives the optimal nutrition and immune protection provided by breast milk.

1. 8 Breastfeeding Support: Seek support from a lactation consultant, healthcare professional, or a local breastfeeding support group if there are any challenges or concerns. They can provide guidance, reassurance, and troubleshooting assistance to establish and maintain exclusive breastfeeding.

Remember, exclusive breastfeeding for the first six months is recommended by major health organizations like the World Health Organization (WHO) and the American Academy of Paediatrics (AAP). However, individual circumstances may vary, and it's important to consult with healthcare provider for personalized advice based on specific situation.

5. 2. 2. NUTRITIONAL REQUIREMENTS FOR LACTATING MOTHERS:

The nutritional requirements for lactating mothers in India are generally based on the Recommended Dietary Allowances (RDA) established by the Indian Council of Medical Research (ICMR). Here are the key nutritional requirements for lactating mothers based on the RDA for Indian women:

2. 1 Calories: Lactating mothers require additional energy to support milk production. The RDA suggests an additional 550 calories per day during the first six months of lactation and an extra 400 calories per day during the next six months.

2. 2 Protein: Adequate protein intake is crucial for milk production and tissue repair. The RDA recommends 60 grams of protein per day for lactating mothers.

2. 3 Iron: Iron is important to replenish iron stores for preventing anaemia. The RDA suggests a daily intake of 27 milligrams of iron for lactating mothers.

2. 4 Calcium: Sufficient calcium intake is essential for maintaining bone health. The RDA recommends a daily intake of 1,000 milligrams of calcium for lactating mothers.

2. 5 Vitamin A: Vitamin A is important for the mother's health and the development of the baby. The RDA suggests a daily intake of 800 micrograms of vitamin A for lactating mothers.

2. 6 Vitamin C: Vitamin C supports the immune system and enhances iron absorption. The RDA recommends a daily intake of 40 milligrams of vitamin C for lactating mothers.

2. 7 Vitamin D: Vitamin D is crucial for bone health. The RDA suggests a daily intake of 600 International Units (IU) of vitamin D for lactating mothers.

2. 8 Vitamin B12: Vitamin B12 is important for nerve function and the production of red blood cells. The RDA recommends a daily intake of 2.6 micrograms of vitamin B12 for lactating mothers.

2. 9 Iodine: Iodine is essential for thyroid function and the baby's brain development. The RDA suggests a daily intake of 250 micrograms of iodine for lactating mothers.

2. 10 Omega-3 Fatty Acids: Omega-3 fatty acids, particularly DHA, are important for the baby's brain and eye development. The RDA does not provide specific recommendations for omega-3 fatty acids, but including good sources like fatty fish, flaxseeds, and walnuts in the diet is beneficial.

5. 2. 3. DIETARY CONCERNS FOR LACTATING MOTHER:

A lactating mother's dietary pattern should focus on providing adequate nutrition for her baby. Here are some key points to consider:

3. 1 Sufficient Calories: Lactation requires additional energy, so it's important to consume enough calories to support milk production and meet your own energy needs. Aim for an additional 500-800 calories per day above your pre-pregnancy intake, depending on your activity level and individual needs.

3. 2 Nutrient-Dense Foods: Focus on consuming a variety of nutrient-dense foods to ensure an adequate intake of vitamins, minerals, and essential nutrients. Include fruits, vegetables, whole grains, lean proteins, legumes, nuts, and seeds in your diet.

3. 3 Protein: Adequate protein intake is crucial for milk production and repair of body tissues. Include sources of lean protein such as poultry, fish, eggs, dairy products, legumes, and tofu in your meals.

3. 4 Healthy Fats: Include sources of healthy fats like avocados, nuts, seeds, fatty fish (e. g. , salmon, sardines), olive oil, and coconut oil. These fats provide essential fatty acids and support brain development in your baby.

3. 5 Calcium: Calcium is important for bone health, and lactating mothers have increased calcium needs. Include calcium-rich foods such as dairy products (milk, yogurt, cheese), leafy green vegetables, tofu, and fortified plant-based milk alternatives.

3. 6 Iron: Iron is necessary for both mother and baby's health, especially to prevent postpartum anaemia. Include iron-rich foods such as lean meats, poultry, fish, legumes, leafy green vegetables, fortified cereals, and dried fruits.

3. 7 Hydration: Drink plenty of fluids to stay hydrated, as breastfeeding can increase your water

needs. Aim for at least 8-10 cups of fluids per day, including water, herbal teas, and soups.

3. 8 Omega-3 Fatty Acids: Omega-3 fatty acids, particularly DHA, are important for your baby's brain and eye development. Include sources of omega-3 fatty acids such as fatty fish (e. g. , salmon, trout), walnuts, chia seeds, and flaxseeds.

3. 9 Limit Caffeine and Alcohol: Limit your intake of caffeine and avoid excessive alcohol consumption. High levels of caffeine may affect your baby's sleep patterns, and alcohol can pass into breast milk and harm your baby.

3. 10 Considerations for Food Sensitivities: If your baby shows signs of food sensitivities or allergies, such as fussiness or digestive issues, may need to modify the diet. Common allergenic foods include cow's milk, eggs, peanuts, tree nuts, soy, wheat, and fish. Consulting with a healthcare professional or a registered dietitian can provide guidance in such cases.

Remember, every individual's nutritional needs can vary, so it's essential to listen to your body and consult with a healthcare professional or a registered dietitian for personalized advice based on specific needs and circumstances.

5. 2. 4. FEEDING PATTERN FOR LACTATING MOTHER

The feeding pattern for a lactating mother involves establishing a breastfeeding routine that suits both the mother and the baby. Here are some key points to consider:

4. 1 Breastfeed on Demand: Breastfeeding the baby is necessary whenever they show hunger cues, such as rooting, sucking on fists, or increased alertness. Avoid strict schedules and instead follow baby's cues for feeding. This helps to ensure that baby is getting enough milk and supports milk production.

4. 2 Frequency of Feedings: Newborns typically need to nurse at least 8-12 times in 24 hours. This translates to feeding approximately every 2-3 hours, including nighttime feedings. As the baby grows, their feeding frequency may decrease, but they should still have a minimum of 6-8 feedings per day.

4. 3 Length of Feedings: Allow baby to nurse for as long as they need during each feeding. This ensures they receive the necessary milk and helps stimulate milk production. Newborns may breastfeed for about 10-45 minutes per feeding, while older babies may finish more quickly, typically within 10-20 minutes.

4. 4 Effective Latch: Ensuring a proper latch to facilitate efficient milk transfer and prevent nipple soreness. Position your baby so that their mouth covers a large portion of the areola (the darker area around the nipple) to ensure they are effectively extracting milk.

4. 5 Nursing from Both Breasts: Offer each breast at each feeding to ensure balanced milk production and to satisfy your baby's hunger. Start with one breast per feeding and let your baby nurse until they show signs of being finished or become less interested. Then, offer the other breast.

4. 6 Nighttime Feedings: Nighttime feedings are important for maintaining milk supply and meeting your baby's nutritional needs. Consider co-sleeping or keeping your baby's crib near your bed for easier access during nighttime feedings.

4. 7 Pumping and Storing Breast Milk: If you need to be separated from baby or want to build a supply of expressed milk, consider incorporating pumping sessions into your feeding routine. Pumping can help maintain milk supply and provide milk for occasions when mother is not available to breastfeed. One should follow proper guidelines for storing breast milk, including using sterilized containers, labelling with date and time, and storing at the appropriate temperature.

4. 8 Seek Support: If you have any concerns or difficulties with breastfeeding or establishing a feeding pattern, seek support from a lactation consultant, healthcare professional, or a local breastfeeding support group. They can provide guidance, answer your questions, and help address any challenges you may encounter. Remember, each baby and mother pair is unique, and the feeding pattern may vary. Trust your instincts, listen to your baby's cues, and consult with healthcare professionals for personalized guidance and support.

5. 2. 5. THE LET-DOWN REFLEX

The let-down reflex, also known as the milk ejection reflex, is a natural physiological process that allows the release of breast milk from the mammary glands to the nipple.

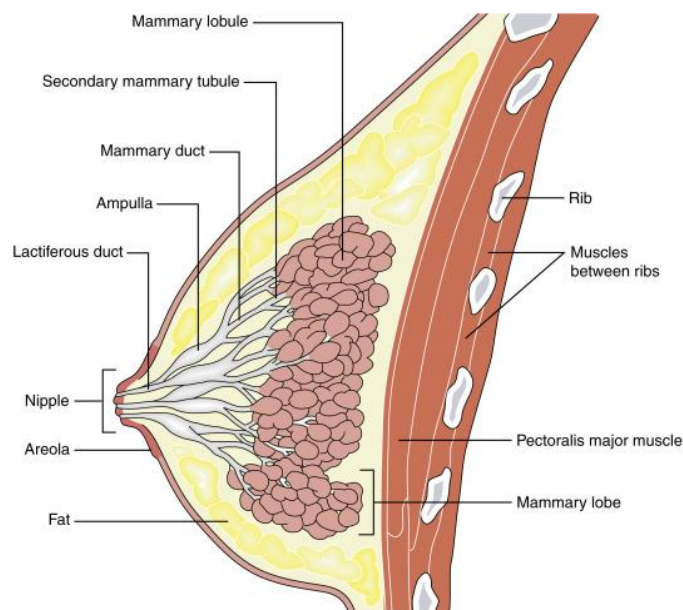


Fig 1: Mammary glands

Here are some key points about the let-down reflex:

5. 1 Stimulation: The let-down reflex is triggered by a combination of physical and psychological factors. Physical stimulation can occur through the baby's sucking at the breast or by using a breast pump. The sight, sound, or smell of the baby, as well as feelings of relaxation and emotional connection, can also contribute to the release of the hormone oxytocin, which plays a central role in the let-down reflex.

5. 2 Oxytocin Release: Oxytocin is a hormone produced by the hypothalamus and released by the pituitary gland in response to nipple stimulation or other cues mentioned above. Oxytocin stimulates the contraction of the muscle cells surrounding the milk-producing glands, causing the milk to be ejected into the milk ducts.

5. 3 Milk Ejection: As oxytocin is released, it causes rhythmic contractions of the muscle cells, resulting in the milk being forced through the ducts and out of the nipple. This allows the baby to obtain a steady flow of milk during breastfeeding.

5. 4 Sensations: Women may experience different sensations during let-down. Some may feel a tingling or pins-and-needles sensation in the breasts, while others may feel a subtle or strong feeling of milk release. These sensations can vary from person to person and may change over time.

5. 5 Timeframe: The let-down reflex typically occurs a few minutes after breastfeeding or pumping has begun. However, the timing can vary. Some women may experience a rapid let-down, while

others may take a bit longer for the milk to flow.

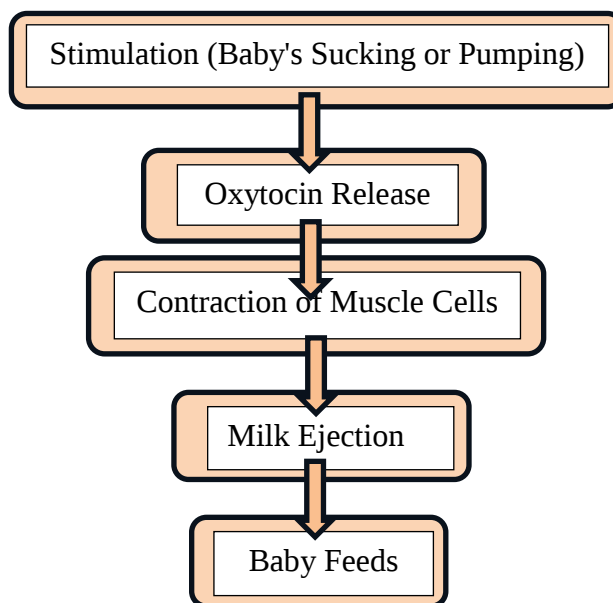


Fig. 2: Let- Down Reflex

It's important to note that some women may experience challenges with the let-down reflex, such as low milk supply, delayed let-down, or overactive let-down. If you have concerns about let-down reflex or breastfeeding in general, it's recommended to seek support from a lactation consultant or healthcare provider who can provide guidance and assistance.

5. 2. 6. MYTHS RELATED TO LACTATION

There are several myths and misconceptions related to lactation (the production and secretion of breast milk). Here are a few common ones:

6. 1 Myth: Breastfeeding causes sagging breasts.

Fact: Breastfeeding itself does not cause breasts to sag. The changes in breast shape and size that occur during pregnancy are primarily due to hormonal changes, not breastfeeding. The ligaments that support breast tissue can stretch during pregnancy, leading to sagging, but this is not caused by breastfeeding.

6. 2 Myth: Small-breasted women can't produce enough milk.

Fact: Breast size does not determine a woman's ability to produce milk. Milk production depends on the stimulation and emptying of the breasts, which is primarily driven by the baby's demand for milk. Small-breasted women can produce just as much milk as women with larger breasts.

6. 3 Myth: Breast milk loses its nutritional value after a certain period.

Fact: Breast milk is a highly nutritious and complete food for babies. Its composition adjusts to meet the changing needs of the growing infant. While the specific composition may change over time, breast milk remains a valuable source of nutrition for as long as the mother continues to breastfeed.

6. 4 Myth: Formula feeding is equivalent to breastfeeding.

Fact: While infant formula can provide adequate nutrition for babies, it does not replicate the numerous health benefits of breast milk as it contains antibodies that help protect infants from infections, promotes optimal brain development, and supports the baby's immune system. Breastfeeding has been associated with a lower risk of certain diseases in both infants and mothers.

6. 5 Myth: You need to drink milk to produce milk.

Fact: While maintaining good hydration is important for overall health, drinking cow's milk is not a requirement for producing breast milk as it is produced by the mammary glands in response to the baby's suckling and removal of milk from the breasts. A breastfeeding mother should focus on consuming a well-balanced diet and staying adequately hydrated.

6. 6 Myth: You should stop breastfeeding when you have a cold or fever.

Fact: It is generally safe to continue breastfeeding when you have a cold or fever. In fact, the antibodies present in breast milk can help protect your baby from getting the same illness. Most illnesses do not require stopping breastfeeding, and it is usually more beneficial for both the mother and the baby to continue breastfeeding.

It's important to seek accurate information about lactation and consult with healthcare professionals or lactation consultants if one can have any concerns or questions about breastfeeding.

5. 2. 7. FADS RELATED TO LACTATION

Few common fads or trends related to lactation are following:

7. 1 "Lactation cookies" and other foods claimed to increase milk supply: There is a popular belief that certain foods, such as lactation cookies or herbal supplements, can increase milk supply. However, there is limited scientific evidence to support these claims. While some ingredients like oats or flaxseeds may have nutritional benefits, it is important to remember that milk supply is primarily driven by the baby's demand and effective breastfeeding practices.

7. 2 "Breastfeeding teas" and herbal supplements: Similar to lactation, there are various breastfeeding teas and herbal supplements on the market that claim to enhance milk production. However, the effectiveness and safety of these products are not well-established. It's important to consult with a healthcare professional before using any herbal remedies or supplements, as they may have potential side effects or interact with medications.

7. 3 Pumping or expressing milk to increase supply: Some people believe that pumping or expressing breast milk in between feedings can increase milk supply. While pumping can be helpful in establishing and maintaining milk supply, simply pumping without addressing the underlying issue of ineffective milk removal which may not lead to increased production. The baby's direct suckling at the breast is generally more effective in stimulating milk production than pumping alone.

7. 4 "Power pumping" or cluster pumping: Power pumping involves mimicking cluster feeding by pumping in short bursts with breaks in between. It is believed to stimulate milk production. While some women find this technique helpful, there is limited scientific evidence to support its effectiveness in increasing milk supply. The key to boosting milk supply is generally frequent and effective milk removal, whether through direct breastfeeding or pumping.

7. 5 Exclusive consumption of certain foods or supplements for better milk quality: There is a misconception that consuming specific foods or supplements can enhance the quality or nutritional content of breast milk. While it is important to maintain a balanced diet and stay adequately nourished, breast milk naturally provides the essential nutrients a baby needs. A well-rounded diet and appropriate hydration are generally sufficient for producing healthy breast milk.

It's crucial to approach these fads with caution and rely on evidence-based information. If you have concerns about milk supply or breastfeeding, it's recommended to consult with a healthcare professional or a lactation consultant who can provide personalized guidance and support.

5. 2. 8. PHYSIOLOGY OF LACTATION

8. 1 Hormonal Control: Lactation is primarily regulated by a complex interplay of hormones. During pregnancy, the placenta secretes hormones, including estrogen, progesterone, and human placental lactogen (hPL), which prepare the breasts for milk production. After childbirth, when the placenta is expelled, hormone levels shift, and lactation is initiated.

8. 2 The key hormones involved in lactation are:

8. 2. 1 Prolactin: Produced by the pituitary gland, prolactin stimulates the mammary glands to produce milk. Suckling or breast stimulation triggers prolactin release.

8. 2. 2 Oxytocin: Also produced by the pituitary gland, oxytocin plays a vital role in milk ejection or let-down. It causes the muscles around the milk-producing cells (alveoli) to contract, allowing milk to flow through the milk ducts and be released from the nipple. Oxytocin release is triggered by the baby's suckling and nipple stimulation.

8. 3 Milk Production: Milk production occurs within the mammary glands, which are made up of lobes containing smaller structures called lobules. Each lobule contains clusters of milk-producing cells called alveoli. The process of milk production involves the following steps:

8. 4 Secretory Activation: During pregnancy, the alveoli start to multiply and differentiate under the influence of hormones. This process, known as secretory activation which prepares the mammary glands for milk production.

8. 5 Milk Synthesis: After childbirth, the prolactin hormone stimulates the alveolar cells to synthesize milk components. The primary constituents of breast milk include lactose (sugar), proteins (such as casein and whey proteins), fats, vitamins, and minerals. The mammary glands extract these substances from the bloodstream and transport them into the alveoli.

8. 6 Milk Secretion: Once milk is synthesized in the alveoli, it is stored within small cavities called alveolar lumens. As the alveoli fill with milk, pressure builds up, and the milk is forced into larger ducts within the breast.

8. 7 Milk Ejection or Let-Down: Milk ejection, also known as let-down, refers to the release of milk from the breast into the baby's mouth. It is triggered by the release of oxytocin in response to nipple stimulation or the baby's suckling.

The steps involved in milk ejection are as follows:

8. 7. 1 Reflex Stimulation: The baby's suckling or the sensation of the baby at the breast sends nerve signals to the brain, specifically the hypothalamus.

8. 7. 2 Oxytocin Release: The hypothalamus then signals the pituitary gland to release oxytocin into the bloodstream.

8. 7. 3 Contraction of Myoepithelial Cells: Oxytocin causes the myoepithelial cells surrounding the alveoli and milk ducts to contract. This contraction pushes the milk forward through the ducts towards the nipple.

8. 7. 4 Milk Flow: As the milk is forced towards the nipple, it is released from the milk ducts and can be sucked by the baby.

8. 7. 5 Milk Supply and Demand: The production and maintenance of an adequate milk supply is regulated by the principle of supply and demand. The more frequently and effectively the baby breastfeeds, the more milk is produced.

8. 8 Factors influencing milk supply:

The following factors influence milk supply:

8. 8. 1 Demand: The baby's frequent and effective removal of milk from the breast signals the mammary glands to produce more milk. Emptying the breasts fully during each feeding session stimulates ongoing milk production.

8. 8. 2 Milk Removal: Incomplete milk removal from the breasts, such as infrequent or ineffective breastfeeding, can lead to reduced milk supply. It is essential to establish a regular and effective breastfeeding routine.

8. 8. 3 Hormonal Balance: Hormonal imbalances, such as polycystic ovary syndrome (PCOS) or certain medications, can affect milk supply. Consulting with a healthcare professional or a lactation consultant can help address any underlying issues.

Understanding the physiology of lactation can help mothers establish and maintain a successful breastfeeding relationship with their infants. If you have specific concerns or challenges with lactation, it is advisable to seek support from healthcare professionals or lactation consultants who can provide individualized guidance.

5. 2. 9. BREASTFEEDING POSITIONS AND GUIDELINES FOR MOTHERS:

Breastfeeding positions are important for mothers for several reasons:

9. 1. 1 Comfort: Finding a comfortable breastfeeding position is crucial for the mother's physical comfort during nursing sessions. The right position can help prevent back, shoulder, and neck pain by providing proper support and alignment for the mother's body.

9. 1. 2 Preventing nipple pain and damage: A correct breastfeeding position allows for a proper latch, which is essential for effective milk transfer and prevents nipple pain, soreness, and damage. When the baby latches onto the breast correctly, they are able to take in a mouthful of breast tissue along with the nipple, reducing the likelihood of nipple trauma.

9. 1. 3 Milk supply and flow: Certain breastfeeding positions, such as the laid-back position or the side-lying position, can help with milk supply and flow. These positions allow for better drainage of the milk ducts, which can enhance milk production and prevent issues like engorgement or plugged ducts.

9. 1. 4 Bonding and emotional connection: Breastfeeding is not just about providing nutrition; it is also a time for bonding and establishing an emotional connection between the mother and the baby. Finding a comfortable and nurturing position can enhance this bonding experience, allowing the mother to relax and enjoy the closeness with her baby.

9. 1. 5 Postpartum recovery: Breastfeeding positions can also play a role in the mother's postpartum recovery. For example, the football hold or the laid-back position can be helpful for mothers who have had a caesarean birth, as they minimize pressure on the incision site. Choosing positions that prioritize the mother's comfort can contribute to a smoother postpartum healing process.

It's important for each mother to experiment with different breastfeeding positions and find the ones that work best for her baby. Additionally, seeking support from a lactation consultant or attending breastfeeding support groups can provide valuable guidance and assistance in finding comfortable and effective breastfeeding positions.

Common Breastfeeding Positions



Laid-back nursing position
Used from first breastfeeding and great for anyone



Cross-cradle hold
Helpful for premies, newborns, or babies with trouble latching on



Football hold
Good for nursing twins, c-section recovery, large breasts, and flat or inverted nipples



Cradle hold
Comfortable once baby latches on



Side-lying position
Great for nighttime feedings and c-section recovery

Various breastfeeding positions and guidelines for mothers are as follows:

9. 2. 1 Cradle Hold: The cradle hold is one of the most common breastfeeding positions. Sit in a comfortable chair with good back support. Hold baby's head in the crook of arm on the same side as the breast you will be nursing from. Support baby's body with forearm and hand, ensuring their head and neck are in perfect alignment. Bring baby's mouth to nipple, aiming the nipple towards the baby's upper lip. Ensure baby's mouth covers a large portion of the areola (the darker area around the nipple).

9. 2. 2 Football Hold: The football hold is helpful for mothers who had a caesarean birth or who have large breasts. Sit in a comfortable chair and tuck baby under arm on the same side as the breast you will be nursing from. Support baby's body with forearm and hand, positioning their legs towards back. Ensure baby's head and neck are in alignment, and their mouth is at the level of nipple. Support breast with other hand, forming a "C" shape to provide additional support and control.

9. 2. 3 Side-Lying Position: The side-lying position is useful for nighttime feedings or when both you and your baby want to lie down. Lie on your side with a pillow behind your back for support. Position your baby facing you, tummy to tummy, and use your lower arm to support your baby's head and neck. Use your upper arm to support your breast, gently guiding your nipple to your baby's mouth. Ensure your baby's body is aligned with your body, and both of you are comfortable.

9. 3 Guidelines for Mothers:

9. 3. 1 Proper Latch: Ensure a deep latch, where your baby takes in a good portion of the areola along with the nipple. This ensures effective milk transfer and helps prevent nipple soreness.

9. 3. 2 Comfortable Position: Sit in a comfortable position with good back support. Use pillows or cushions as needed to support arms, back, and the baby.

9. 3. 3 Correct Alignment: Position your baby so that their head, neck, and body are in alignment

during breastfeeding. This helps prevent strain on baby's neck and ensures proper milk flow.

9. 3. 4 Watch for Hunger Cues: Look for early hunger cues such as rooting, sucking on fists, or lip smacking, and offer the breast before your baby becomes overly hungry or fussy.

9. 3. 5 Frequency and Duration: Breastfeed baby on demand, as newborns typically need to nurse at least 8 to 12 times in 24 hours. Allow your baby to nurse for as long as they need to ensure they get enough milk.

9. 3. 6 Proper Burping: After each feeding, burp baby by holding them upright or gently patting their back. This helps prevent discomfort from trapped air.

9. 3. 7 Seek Support: If you have difficulties or concerns with breastfeeding, seek support from a lactation consultant, healthcare professional, or a local breastfeeding support group. Remember that each mother and baby pair may find different positions and techniques more comfortable. It's important to find what works best for you and your baby.

5. 2. 10. BREASTFEEDING COMPLICATIONS AND THEIR POSSIBLE SOLUTIONS:

10. 1 Sore Nipples:

Possible Causes: Poor latch, incorrect positioning, tongue-tie, or thrush (yeast infection).

Solutions: Ensure a deep latch, seek assistance from a lactation consultant to improve positioning, treat any underlying issues like tongue-tie or thrush, apply lanolin or nipple creams for relief, and allow your nipples to air dry between feedings.

10. 2 Engorgement:

Possible Causes: Excessive milk supply, delayed or infrequent feedings, or ineffective milk removal.

Solutions: Breastfeed frequently and on demand, ensure proper latch and milk removal, apply warm compresses or take a warm shower before feeding to promote milk flow, hand express or use a breast pump to relieve excess milk, and apply cold compresses or chilled cabbage leaves between feedings to reduce swelling.

10. 3 Low Milk Supply:

Possible Causes: Insufficient glandular tissue, ineffective milk removal, infrequent feedings, or certain medical conditions.

Solutions: Ensure proper latch and milk removal, breastfeed frequently and on demand, consider power pumping or cluster feeding to stimulate milk production, practice breast compression during feedings to increase milk transfer, consult a lactation consultant or healthcare professional for guidance, and consider lactation-supportive supplements or medications under professional supervision.

10. 4 Oversupply of Milk:

Possible Causes: Overactive let-down reflex, frequent or prolonged feedings on one breast, or excessive pumping.

Solutions: Nurse in a reclined position to reduce the force of the milk flow, nurse on one breast per feeding to allow baby to access the fatty hindmilk, hand express or use a breast pump before feeding to relieve pressure, and seek support from a lactation consultant for managing oversupply.

10. 5 Mastitis:

Possible Causes: Bacterial infection from cracked nipples, engorgement, or blocked milk ducts.

Solutions: Ensure proper latch and milk removal, apply warm compresses and gentle massage to the affected area, nurse frequently on the affected breast, rest and get adequate fluids, take prescribed antibiotics if necessary, and seek medical attention if symptoms worsen or persist.

10. 6 Plugged Milk Ducts:

Possible Causes: Milk stasis due to incomplete milk removal, pressure on the breast, or tight clothing.

Solutions: Ensure complete milk removal through breastfeeding, pumping, or hand expression, apply warm compresses and gentle massage to the affected area, nurse with different positions to promote milk drainage, avoid tight clothing or pressure on the breasts, and seek guidance from a lactation consultant if the issue persists.

It's important to consult with a healthcare professional, such as a lactation consultant or doctor, for a proper assessment and personalized solutions if you experience any breastfeeding complications. They can provide guidance tailored to your specific situation.

5. 2. 11. BENEFITS OF BREASTFEEDING OVER BOTTLE FEEDING:

Breastfeeding offers numerous benefits for both the baby and the mother when compared to bottle feeding. Some of the benefits of breastfeeding are summed up here:

11. 1 Benefits for the Baby:

11. 1. 1 Optimal Nutrition: Breast milk is uniquely designed to meet the nutritional needs of infants. It contains the perfect balance of carbohydrates, proteins, fats, vitamins, minerals, and antibodies. Breast milk composition adjusts to meet the changing needs of the baby as they grow.

11. 1. 2 Immune System Support: Breast milk contains antibodies, immune cells, and other components that help protect the baby against infections and diseases. It helps reduce the risk of respiratory infections, ear infections, gastrointestinal infections, and certain chronic conditions such as asthma and allergies.

11. 1. 3 Digestive Health: Breast milk is easily digested by the baby's immature digestive system, reducing the likelihood of digestive issues such as constipation and diarrhoea. Breastfed babies have a lower risk of developing gastrointestinal disorders like necrotizing enterocolitis (NEC).

11. 1. 4 Cognitive Development: Breast milk contains essential fatty acids, such as DHA (docosahexaenoic acid), which are important for brain development and cognitive function. Breastfed babies may have a slightly higher IQ and improved cognitive development compared to those who are formula-fed.

11. 1. 5 Allergy Prevention: Breastfeeding can help reduce the risk of allergies and allergic diseases, including eczema, asthma, and food allergies. The unique composition of breast milk and the antibodies it contains help protect against allergic reactions.

11. 1. 6 Reduced Risk of Obesity: Breastfeeding has been associated with a lower risk of childhood obesity later in life. Breast milk composition helps regulate appetite, promotes healthy weight gain, and supports the development of a healthy metabolism.

11. 2 Benefits for the Mother:

11. 2. 1 Bonding and Emotional Connection: Breastfeeding provides an opportunity for skin-to-skin contact and promotes a strong emotional bond between the mother and the baby. The release of oxytocin during breastfeeding promotes feelings of love, nurturing, and relaxation.

11. 2. 2 Postpartum Recovery: Breastfeeding stimulates the release of hormones that help the

uterus return to its pre-pregnancy size more quickly. It may also help reduce postpartum bleeding and promote weight loss.

11. 2. 3 Reduced Risk of Certain Diseases: Breastfeeding has been associated with a lower risk of certain diseases in mothers, such as breast cancer, ovarian cancer, and type 2 diabetes. The longer the duration of breastfeeding, the greater the protective effect.

11. 2. 4 Cost and Convenience: Breastfeeding is cost-effective as it does not require the purchase of formula, bottles, or sterilization equipment. It is readily available and always at the right temperature, making it convenient for on-demand feeding.

11. 2. 5 Environmental Impact: Breastfeeding has a minimal environmental impact compared to the production, packaging, and waste associated with formula feeding.

It's important to note that while breastfeeding offers numerous benefits, individual circumstances may vary. The choice between breastfeeding and bottle feeding should be based on the mother's health, preferences, and any specific medical considerations. Consulting with healthcare professionals can provide personalized guidance and support in making an informed decision.

5.3 LET US SUM UP

This unit provided an in-depth understanding of nutrition in special conditions, focusing on pregnancy and lactation. It began by discussing the nutritional needs during pregnancy, emphasizing the objectives and the critical role of adequate nutrient intake for the health of both mother and fetus. The diet patterns, feeding practices, and factors influencing diet planning during pregnancy were outlined, alongside addressing common nutritional problems, food fads, and myths. Moving on to lactation, we explored the importance of exclusive breastfeeding, nutritional requirements for lactating mothers, and dietary concerns to ensure optimal milk production and maternal health. Key topics included the physiology of lactation, the let-down reflex, breastfeeding positions, and guidelines for mothers, as well as managing complications and understanding the benefits of breastfeeding over bottle feeding. Myths and fads related to lactation were also debunked, providing clarity and practical insights for effective breastfeeding practices. This unit highlighted the importance of informed nutrition and care during these special conditions for promoting maternal and child well-being.

5.4 CHECK YOUR PROGRESS

Short Questions

1. What is the primary objective of nutrition during pregnancy?
2. Name two nutrients essential for fetal growth during pregnancy.
3. Define the physiology of lactation in brief.
4. Mention any two food fads commonly observed during pregnancy.
5. List one factor affecting diet planning during lactation.

Long Questions

1. Explain the nutrient requirements and diet patterns during pregnancy to support maternal and fetal health.
2. Discuss the physiology of lactation and its implications for dietary planning.
3. Describe the feeding patterns and factors affecting diet planning during lactation.

4. Analyze the impact of food fads during pregnancy and lactation on maternal and child health.
5. Illustrate how cultural and economic factors influence diet planning during pregnancy and lactation.

UNIT-6 : NUTRITION DURING INFANCY AND CHILDHOOD

Structure :

6. 1 Introduction

- 6. 1. 1 Infant Nutrition
- 6. 1. 2 Needs and Objectives
- 6. 1. 3. Nutrient Requirements during Infancy
- 6. 1. 4. Diet Pattern of Infants
- 6. 1. 5. Feeding Pattern
- 6. 1. 6. Factors Affecting Diet Planning

6.2 Nutrition During Childhood

- 6.2.1 Childhood Nutrition
- 6.2.2 Needs And Objectives
- 6.2.3 Nutrient Requirement
- 6.2.4 Diet Pattern
- 6.2.5 Feeding Pattern
- 6.2.6 Factors Affecting Diet Planning
- 6.2.7 Nutrition Problems During Childhood
- 6.2.8 Let Us Sum Up
- 6.2.9 Check Your Progress

6. 1 INTRODUCTION

6. 1. 1. INFANT NUTRITION

Infancy is the period from birth of child till first year of life. Adequate nutrition is very essential during this stage, as the foundation for further growth is laid. Apart from this infancy is a fragile period of life. During infancy there are special needs of the body that have to be fulfilled. Infancy is also a time for rapid growth and development. The body weight of an infant at birth is doubled in about 4 to 5 months and within a year it becomes three times his birth weight. Similarly, there is an increase in the length of an infant from 50 cms at the time of birth to 75 cms within a year i. e. by the first birthday, a child becomes one and a half times longer than what he was at the time of birth, no time in life such a spurt in growth occurs which corresponds with high energy and nutrient requirement per unit of body weight. Proper infant nutrition is critical for optimal growth, development, and overall health of the baby.

1. 1 Breast Milk or Formula: Breast milk is the ideal source of nutrition for infants and is recommended as the exclusive source of nutrition for the first six months of life. Breast milk provides all the necessary nutrients, antibodies, and enzymes that support immune function, growth, and brain development. If breastfeeding is not possible or insufficient, infant formula is a safe and nutritionally adequate alternative. One should always consult with healthcare professionals for guidance on choosing the appropriate formula for the baby.

1. 2 Introduction of Solid Foods: Around six months of age, infants should begin receiving

complementary solid foods in addition to breast milk or formula. Mother or caregiver should start with single-ingredient pureed or mashed foods such as iron-fortified infant cereals, fruits, and vegetables.

Gradually, she should introduce a variety of foods to expand their palate and nutrient intake. Mother should remember to introduce one new food at a time and wait for four days before introducing another to monitor for potential allergic reactions. Once, the food becomes familiar to baby she can go further.

1. 3 Nutrient Balance: Mother should ensure a balanced diet by offering a variety of foods from different food groups. She should include fruits, vegetables, whole grains, lean proteins (such as pureed meats, poultry, fish, tofu, or legumes), and healthy fats. Iron-rich foods are particularly important for infants, as iron stores from birth start to deplete around six months. She should try to offer iron-rich foods such as pureed meats, iron-fortified cereals, and legumes.

1. 4 Texture Progression: As the baby grows, gradually she should attempt to introduce more textured foods to encourage chewing and oral motor development. Mother can progress from purees to mashed or finely chopped foods and eventually to age-appropriate finger foods that the baby can pick up and self-feed.

1. 5 Allergenic Foods: While practicing weaning mother should introduce potentially allergenic foods (e. g. , eggs, peanuts, tree nuts, soy, wheat, fish) one at a time, starting with a small amount, to monitor for allergic reactions. There is no need to delay the introduction of these foods beyond six months, as research suggests early introduction may actually reduce the risk of allergies.

1. 6 Hydration: Baby should be offered water in a sippy cup or open cup starting around six months of age, particularly when introducing solid foods. Water helps to keep the baby hydrated, especially during hot weather or when the baby is showing signs of thirst.

1. 7 Avoidance of Added Sugars and Salt: Mother should be aware of the fact that fruits food group should be the last group to be introduced to the babies and they should minimize or avoid added sugars and salt in the baby's diet, as their kidneys and taste preferences are still developing. Mother should avoid giving honey to infants under one year of age due to the risk of botulism.

1. 8 Responsive Feeding: Mothers of infants should be encouraged to practice responsive feeding by paying attention to the baby's hunger and fullness cues. They should allow the baby to determine how much they want to eat, avoiding force-feeding or pressuring the baby to finish a specific amount.

1. 9 Continued Breastfeeding: If breastfeeding is established, continue breastfeeding alongside the introduction of solid foods, as breast milk remains an important source of nutrition, immune factors, and bonding.

1. 10 Consultation and Guidance: Mothers should consult the healthcare professionals, such as paediatricians or registered dietitians, for personalized guidance and to address any specific concerns or individual needs of the baby.

Remember, every baby is different, and their nutritional needs may vary. It is important to monitor growth, development, and consult with healthcare professionals to ensure the baby's nutritional needs are met and to address any specific concerns.

6. 1. 2. NEEDS AND OBJECTIVES:

The needs and objectives of nutrition during infancy are focused on promoting optimal growth, development, and overall health.

2. 1 Adequate Nutrient Intake: Infants have high nutrient requirements to support their rapid growth and development.

The objective of the infant nutritional planning is to ensure an adequate intake of macronutrients (carbohydrates, proteins, and fats) and micronutrients (vitamins and minerals) to meet the infant's nutritional needs.

2. 2 Optimal Growth: Adequate nutrition during infancy is crucial for promoting healthy growth.

The objective is to support steady weight gain, lengthening, and head circumference growth, which are the indicators of overall development.

2. 3 Brain and Nervous System Development: Infancy is a critical period for brain and nervous system development.

The objective is to provide adequate nutrients, particularly omega-3 fatty acids, such as DHA (docosahexaenoic acid), which is essential for the brain development and cognitive function.

2. 4 Immune System Support: The infant's immune system is still developing and requires proper nutrition to support immune function. The objective is to provide nutrients that support the development of a strong immune system, such as through breastfeeding, which provides antibodies and other immune-boosting factors.

2. 5 Bone and Teeth Development: Calcium and vitamin D are essential for the development of strong bones and teeth in the future years. The objective is to ensure adequate intake of these nutrients to support proper bone and teeth formation.

2. 6 Establishing Healthy Eating Habits: Infancy is a critical period for establishing healthy eating habits and preferences. The objective is to introduce a variety of nutritious foods, flavours, and textures to expand the infant's palate and promote acceptance of a wide range of healthy foods.

2. 7 Prevention of Nutritional Deficiencies: Adequate nutrition during infancy helps prevent nutritional deficiencies, such as iron deficiency anaemia.

The objective is to provide sufficient amounts of essential nutrients, including iron, to support optimal health and development.

2. 8 Introduction of Allergenic Foods: Early introduction of potentially allergenic foods, under appropriate guidance, may help reduce the risk of allergies. The objective is to introduce allergenic foods gradually, one at a time, to monitor for any allergic reactions and to promote tolerance.

2. 9 Hydration: Adequate hydration is essential for the infant's overall health and well-being.

The objective is to offer water in addition to breast milk or formula once solid foods are introduced to maintain proper hydration.

2. 10 Support for Breastfeeding: For infants who are breastfed, nutrition during infancy includes supporting breastfeeding practices.

The objective is to encourage exclusive breastfeeding for the first six months and continued breastfeeding alongside the introduction of solid foods.

Overall, the needs and objectives of nutrition during infancy aim to provide the necessary nutrients for growth, development, and the establishment of healthy eating habits. It is important to consult with healthcare professionals, such as paediatricians or registered dietitians, to ensure individualized nutrition recommendations and address any specific concerns or needs of the infant.

6. 1. 3. NUTRIENT REQUIREMENTS DURING INFANCY:

Nutrient requirements of infants are essential to support their rapid growth and development during the first year of life which is considered very crucial period. The exclusive breastfeeding is essential for first 6 months of life. Weaning foods are then gradually introduced to meet the increasing demands which couldn't be met by breastmilk alone later on. The appropriate choice and selection of food groups while preparation of weaning foods is mandatory so as to meet the nutrient demands of the growing baby.

Table. 1: SUMMARY OF RDAs FOR INDIANS(INFANT) -2020

Age Group	Category of work	Body Wt	Protein	CHO	Cal cium	Magne sium	Iron	Zinc	Iodine	Thiamine	Ribo flavin	Niacin	Vit B6	Folate	Vit B12	Vit C	Vit A	Vit D
		(kg)	(g/d)	(g/d)	(mg/d)	(mg/d)	(mg/d)	(mg/d)	(µg/day)	(mg/d)	(mg/d)	(mg/d)	(mg/d)	(µg/d)	(µg/d)	(mg/d)	(µg/d)	(IU/d)
Infants	0-6 m*	5.8	8.1	55	300	30	-	-	100	0.2	0.4	2	0.1	25	1.2	20	350	400
	6-12m	8.5	10.5	95	300	75	3	2.5	130	0.4	0.6	5	0.6	85	1.2	27	350	400

Generally, an infant depends completely on mother's milk for the first few months. Thus, adequate nutrition is essential for the lactating mother. If adequate nutrition is maintained during lactation, there will be proper milk production not only in terms of quantity, but also in terms of quality. Thus, the mother's milk will contain all the nutrients particularly the vitamins and minerals in adequate amounts which will be able to meet the needs of the child upto 6 months. Later on, the complimentary feeding or weaning foods are introduced to the child slowly and gradually.

The nutrient demands of the infants are briefed as follows:

3. 1 Energy: Infants have high energy needs to support their growth and metabolic processes. Infancy is the period of rapid growth, nutrient requirements per kilogram of body weight are proportionally higher than at any other time in the life cyclic. Their basal and total energy needs are comparatively higher at 92 kcal/kg body weight when compared with energy values for adults i. e. 40kcal/kg body weight.

0-6 months 92 kcal/kg/day

7-12 months 80kcal/kg/day

An infant's energy needs depend on number of factors like- body size and composition, metabolic rate, physical activity (active movements), size at birth, age, sex, genetic factors, energy intake, medical conditions, ambient temperature and growth rate. Breast milk or infant formula provides the majority of the infant's energy needs during the first six months of life.

3. 2 Protein: Protein is crucial for the growth and development of tissues, muscles, and organs, production of enzymes, hormones, antibodies, and other regulatory protein components.

The recommended protein intake for infants is around 9-11 grams per day in the first six months and increases to 11-14 grams per day from 7 to 12 months of age. Breast milk or formula provides adequate protein for the infant's needs, if consumed in sufficient amounts necessary to meet energy needs.

3. 3 Carbohydrates: Carbohydrates provide energy and are the primary fuel source for the brain. The recommended carbohydrate intake for infants is around 60grams/day (0-6 months) and 95 grams/day (7-12 months). Lactose, a carbohydrate found in breast milk and most infant formulas, is easily digestible and provides a significant portion of the infant's carbohydrate needs. Carbohydrates supply food for energy, body functions and activity; performs protein sparing action; allow for the normal use of fats in the body; and provide the building blocks for some essential body compounds.

3. 4 Fats: Fats are essential for the development of the infant's brain, nervous system, and overall

growth. The recommended visible fat intake for infants(7-12 months) is around 19-25 grams per day, accounting for approximately 40% of total energy intake.

Breast milk and infant formulas provide an appropriate balance of fats, including essential fatty acids like DHA and AA, which are important for brain development. Lipids are an essential constituent in an infant's diet since they supply a major source of energy consumed in breast milk and infant formula. Fats are vital for providing storage fat accumulation for insulation and body organs protection, absorption of fat-soluble vitamins A,D,E & K. They also provide essential fatty acids that are required for normal brain development, healthy skin and hair, normal eye development, and resistance to infection and disease.

3. 5 Vitamins and Minerals: Infants require a wide range of vitamins and minerals for their growth and development. Breast milk or formula provides most of the essential vitamins and minerals during the first months of life. Vitamin D supplementation is recommended for breastfed infants to ensure adequate levels for bone health. Vitamin A is essential for formation and maintenance of skin, hair and mucous membranes; promotion and maintenance of proper vision; growth and development; healthy immune and reproductive systems. Since, breastmilk is low in Vitamin K, it is recommended that infants should be provided with intramuscular injections. Vitamin C plays a vital role in infants' immunity. Iron is a critical mineral for infants, and iron-rich complementary foods should be introduced around six months of age to prevent iron deficiency. Zinc is the component of many enzymes in the body, is involved in most metabolic processes.

3. 6 Water: Water is essential for maintaining proper hydration, particularly when solid foods are introduced. Breast milk or formula provides a significant amount of water needed for infants during the first months of life. Once solid foods are introduced, small amounts of water can be offered to supplement hydration.

3. 7 Special Considerations: Preterm infants may have increased nutrient requirements and may require specialized formulas or fortification of breast milk to meet their needs. Infants with specific health conditions or developmental issues may have individualized nutrient requirements, requiring close monitoring and guidance from healthcare professionals.

It is important to note that breast milk is considered the gold standard for infant nutrition, as it provides the ideal balance of nutrients and immune-boosting factors. However, if breastfeeding is not possible or insufficient, commercial infant formulas are available as an appropriate alternative.

The specific nutrient requirements of infants may vary based on factors such as gestational age, growth patterns, and individual health conditions. Regular visits to healthcare professionals, such as paediatricians or registered dietitians, can help to ensure that infants receive appropriate nutrition and address any specific concerns or needs.

6. 1. 4. DIET PATTERN OF INFANTS:

The diet pattern of infants evolves as they transition from exclusive breastfeeding or formula feeding to incorporating solid foods into their diet. The extreme careful observation and expertise is required while introducing complimentary feeds among infants. When a child reaches six months of age, the child should receive safe, adequate, nutritious, and age-appropriate complementary foods alongside continued breastfeeding. Appropriate complementary foods (locally available) should be nutrient rich with adequate energy, vitamins, and minerals and without excess fats, salt, and sugar and should follow the frequency, amount, thickness/consistency, variety and active/responsive feeding.

Children have small stomachs, and therefore should be fed on nutrient dense foods, starting with two meals at 6–8 months and gradually increasing 3/4–1 cup, 4–5 times a day at 12–23 months. The consistency of food should gradually evolve with age of the child and according to the child's

requirements and abilities. At one-year, young children should progress from eating soft to semi-solid then to solid food and finally family foods.

Table 2: Summary of the complimentary feeding practices.

Age Group	6–8 Months	9–11 Months	12–23 Months
Frequency	2–3 meals per day plus frequent breastfeeding; based on a child's appetite, 1–2 snacks may be offered	3–4 meals per day plus frequent breastfeeding. Based on a child's appetite, 1–2 snacks may be offered.	3–4 meals per day plus frequent breastfeeding. Based on a child's appetite, 1–2 snacks may be offered.
Amount	Start with 2–3 tablespoons per feed, increasing gradually to ½ of a 250 ml cup	½ cup of a 250 ml at each meal	¾ of a 250 ml cup at each meal
Thickness (consistency)	- Start with thick porridge, well mashed foods. Continue with mashed family foods - Foods prepared with treated water.	- Finely chopped or mashed food and foods that the baby can pick up with his/ her fingers - Wash child's hands if feeding him or herself.	- Family foods, chopped or mashed if necessary - Wash child's hands if feeding him or herself.
Variety	Encourage mothers to include at least one type of locally available food from the three main food groups: Carbohydrates/fats/oils (energy-giving foods), plant/animal protein (bodybuilding), and vegetables and fruits (protecting foods)		
Active/ responsive feeding	Mothers should be encouraged to feed their infants and young children patiently and actively and to use a separate plate for the infant to ensure adequate intake.		
Hygiene	Counsel mothers on hygienic food preparation and handling to avoid food contamination leading to diarrhoea and illness. Encourage the use of clean, open cups. Discourage use of feeding bottles, teats, or spouted cups as they are very difficult to clean.		

Please note in the case of a not breastfed child consider the following:

Table 3: : Complementary Feeding Options for a Non-breastfed Child

Age	Frequency	Amount	Thickness	Variety
6–24 months	Add 1–2 extra meals 1–2 snacks may be offered	Same as above according to age group	Same as above according to age group	Same as above, plus 1 to 2 cups of milk per day + 2–3 cups of extra fluid especially in hot climates.

Source: UNICEF Community IYCF Counselling Package, 2013

4. 1 Exclusive Breastfeeding or Formula Feeding (0-6 months): Breast milk or infant formula is the primary source of nutrition during the first six months of life. Infants should be exclusively breastfed or fed infant formula on demand, typically every 2-3 hours or as per their hunger cues. Breast milk or formula provides all the necessary nutrients for the infant's growth and development, including proteins, fats, carbohydrates, vitamins, minerals, and antibodies.

4. 2 Introduction of Solid Foods (Around 6 months): At around six months of age, infants are ready for complementary solid foods alongside continued breastfeeding or formula feeding. We can start with single-ingredient pureed or mashed foods, such as iron-fortified infant cereals, pureed fruits (e. g. , mashed banana, applesauce), and pureed vegetables (e. g. , mashed sweet potato, carrot puree). One should begin with small spoonful and gradually increase the amount and variety of foods as the infant shows readiness and acceptance.

4. 3 Food Texture Progression (6-12 months): As the baby grows and develops, introduce more textured foods to encourage chewing and oral motor skills. Progress from purees to mashed or finely chopped foods, and eventually to age-appropriate finger foods. Offer a variety of soft cooked

vegetables, fruits, well-cooked grains (e. g. , rice, oatmeal), and small portions of protein sources (e. g. , mashed beans, finely minced meat or fish). Introduce new foods one at a time, with a few days' gap in between each new food, to monitor for any potential allergies or intolerances.

4. 4 Increasing Variety and Nutrient Density (6-12 months): Introduce a wide range of foods to expose the infant to different flavours, textures, and nutrients. Include a variety of fruits, vegetables, whole grains, legumes, lean proteins, and dairy products (if tolerated). Offer foods rich in iron, such as fortified cereals, pureed meats, or iron-rich vegetables like spinach or lentils, to support the baby's iron stores.

4. 5 Meal Frequency (6-12 months): At around six months, start with two to three meals per day, gradually increasing to three meals by 9-12 months. Continue breastfeeding or formula feeding on demand alongside solid foods. Offer solid foods after a breastfeeding or formula feeding session, when the baby is not overly hungry.

4. 6 Fluid Intake (6-12 months): Continue breastfeeding or formula feeding as the primary source of fluids. Offer small sips of water from a sippy cup or an open cup during meal times to supplement hydration, especially when solid foods are introduced.

4. 7 Gradual Transition to Family Foods (12 months and beyond): At around 12 months, infants can start consuming family foods with appropriate modifications in texture and consistency. Continue to provide a balanced diet consisting of a variety of fruits, vegetables, whole grains, lean proteins, and dairy products. Avoid foods high in salt, added sugars, and saturated fats.

4. 8 Limitations and Special Considerations: Avoid honey and cow's milk before one year of age to reduce the risk of infant botulism and potential allergic reactions.

Consult with a paediatrician or registered dietitian for guidance if there is a family history of food allergies or if the infant has specific dietary restrictions or health conditions.

Remember that every infant is unique, and their dietary needs and preferences may vary. Pay attention to the baby's cues, introduce new foods gradually, and create a positive and supportive feeding environment. Regularly monitor growth, consult healthcare professionals, and follow their guidance for a balanced and appropriate diet pattern for your infant.

6. 1. 5. FEEDING PATTERN:

Feeding patterns for infants play a crucial role in ensuring their optimal growth, development, and overall health.

5. 1 First Few Days: During the first few days of life, newborns receive colostrum, a thick and nutrient-rich milk produced by the mother's breasts. Newborns have small stomachs and may require frequent, small feeds (approximately 1-2 ounces or 30-60 milliliters per feeding) every 2-3 hours. Feeding cues, such as rooting, sucking motions, or hand-to-mouth movements, can indicate hunger.

5. 2 Exclusive Breastfeeding or Formula Feeding: Exclusive breastfeeding is recommended as the best source of nutrition for infants during the first six months of life. Breast milk provides optimal nutrition, immune factors, and bonding opportunities. If breastfeeding is not possible or insufficient, commercial infant formulas are a suitable alternative, providing the necessary nutrients for the infant's growth and development.

5. 3 Frequency of Feeding: Infants generally feed 8-12 times per day during the first few weeks of life. Feeding frequency may vary among infants, and it is important to follow the baby's hunger cues and feed on demand. Breastfed infants may feed more frequently due to the faster digestion of breast milk.

5. 4 Length of Feeding: The duration of each feeding session can vary but is typically around 10-30 minutes per breast or bottle. Allow the infant to nurse or bottle-feed at their own pace, as they will naturally release the nipple or stop sucking when they are full.

5. 5 Burping: Burping is important to help the infant release any swallowed air during feeding, reducing discomfort from gas. Gently burp the baby by holding them upright against your shoulder or sitting them up and patting or rubbing their back.

5. 6 Responsive Feeding: Responsive feeding involves paying attention to the infant's hunger and fullness cues and responding accordingly. Feed the baby when they show signs of hunger (such as increased alertness, rooting, or hand-to-mouth movements) and stop when they indicate they are full (turning away from the breast or bottle, becoming less interested, or falling asleep).

5. 7 Introduction of Solid Foods: Around six months of age, infants can start to receive complementary solid foods alongside breast milk or formula. Begin with single-ingredient pureed or mashed foods, such as iron-fortified infant cereals, fruits, and vegetables. Offer small spoonful of food and gradually increase the amount and variety as the baby shows readiness and acceptance.

5. 8 Texture Progression: As the baby grows, introduce more textured foods to encourage chewing and oral motor development. Progress from purees to mashed or finely chopped foods and eventually to age-appropriate finger foods that the baby can pick up and self-feed.

5. 9 Mealtime Environment: Create a calm and nurturing environment during feeding times, minimizing distractions and allowing for bonding between the caregiver and the infant. Sit in a comfortable position while holding the baby, providing eye contact and gentle interaction during feeding.

5. 10 Hydration: Offer small amounts of water in a sippy cup or open cup once solid foods are introduced to supplement hydration. Breast milk or formula remains the primary source of hydration during the first months of life.

5. 11 Scheduled Feeding vs. Baby-Led Feeding: Some caregivers prefer scheduled feeding, following a structured feeding routine with specific time and amount. Others opt for baby-led feeding, where the baby takes the lead in determining the timing and number of feeds. It is important to find a feeding pattern that works best for the baby and the caregiver, ensuring that the baby's nutritional needs are met.

5. 12 Growth Monitoring and Healthcare Visits: Regularly monitor the infant's growth by tracking weight, length, and head circumference. Attend scheduled healthcare visits, such as well-baby checkups, to assess the baby's feeding pattern, growth, and overall health.

Healthcare professionals can provide guidance, address concerns, and ensure that the infant's nutritional needs are being met.

Remember, every infant is unique, and their feeding patterns may vary. It is essential to be responsive to the baby's cues, seek guidance from healthcare professionals, and create a positive feeding environment that promotes healthy eating habits and bonding between the caregiver and the infant.

6. 1. 6. FACTORS AFFECTING DIET PLANNING.

Several factors influence diet planning for infants. It is important to consider these factors to ensure that infants receive a nutritionally balanced and appropriate diet. Here are some key factors that affect diet planning for infants:

6. 1 Age and Developmental Stage: Infants' diet needs change as they grow and develop. The age

and developmental stage of the infant determine the introduction of solid foods and the progression in food textures.

6. 2 Breastfeeding or Formula Feeding: The choice between breastfeeding and formula feeding impacts the composition and nutrient content of the infant's diet. Breast milk and formula provide the foundation of nutrition in the early months of life.

6. 3 Allergies and Intolerances: Some infants may have food allergies or intolerances that require specific dietary modifications. Common allergenic foods, such as peanuts, eggs, dairy, and gluten, may need to be avoided or introduced with caution.

6. 4 Cultural and Family Preferences: Cultural and family preferences influence the types of foods offered to infants. Traditional foods and family dietary habits can shape the introduction of solid foods and food choices.

6. 5 Feeding Readiness and Developmental Readiness: Infants exhibit signs of readiness for solid foods, such as good head control, sitting with support, and showing interest in food. These signs indicate the readiness to transition from exclusive breastfeeding or formula feeding to solid foods.

6. 6 Growth and Weight Status: Monitoring the infant's growth and weight status is important in determining appropriate feeding patterns. Factors such as growth rate, weight gain, and weight loss may impact the timing and quantity of solid foods introduced.

6. 7 Parenting Style and Feeding Practices: Parenting style and feeding practices, such as responsive feeding, baby-led weaning, or scheduled feeding, can influence diet planning. Different approaches may be adopted based on the parent's beliefs, cultural practices, and infant's needs.

6. 8 Dietary Guidelines and Recommendations: Following national or international dietary guidelines and recommendations for infants helps to ensure that they receive the appropriate balance of nutrients. These guidelines provide information on food groups, portion sizes, and nutrient requirements.

6. 9 Availability of Food and Resources: The availability of different types of foods and resources, such as fresh fruits and vegetables, access to clean water, and financial constraints, can impact the variety and quality of foods included in the infant's diet.

6. 10 Healthcare Professional Recommendations: Healthcare professionals, such as paediatricians and registered dietitians, play a crucial role in guiding parents and caregivers on appropriate diet planning for infants. They provide individualized advice based on the infant's health, growth, and specific needs.

It is essential to consider these factors in diet planning for infants to provide a nutritionally balanced and appropriate diet that meets their developmental needs, supports growth, and promotes healthy eating habits. Regular communication with healthcare professionals can provide valuable guidance and ensure that the infant's nutritional needs are met.

6.2 . 1 NUTRITION DURING CHILDHOOD

6. 2. 2 CHILDHOOD NUTRITION:

The role of nutrition during childhood is crucial for the growth, development, and overall well-being of children. Proper nutrition provides the necessary nutrients, energy, and building blocks for various physiological processes and supports cognitive, physical, and emotional development. Here are some important points regarding the role of nutrition during childhood:

1. 1 Growth and Development: Childhood is a period of rapid growth and development. Adequate nutrition, including a balance of macronutrients (carbohydrates, proteins, and fats) and

micronutrients (vitamins and minerals), is essential for optimal growth, bone development, and organ function.

1. 2 Cognitive Development: Nutrition plays a vital role in brain development and cognitive function during childhood. Essential nutrients, such as omega-3 fatty acids, iron, zinc, iodine, and vitamins, support memory, attention, concentration, and learning abilities. Malnutrition or deficiencies in these nutrients can impair cognitive development and academic performance.

1. 3 Immune System Function: Proper nutrition is important for a strong immune system, which helps protect children from infections and illnesses. Key nutrients, such as vitamin C, vitamin A, vitamin D, zinc, and selenium, support immune function and help maintain a healthy immune response.

1. 4 Energy and Physical Activity: Children have high energy needs due to their growth and physical activity levels. A balanced diet provides the energy required for daily activities, sports, and play. Carbohydrates are the primary source of energy, while proteins support muscle growth and repair. Healthy fats are also important for energy and the absorption of fat-soluble vitamins.

1. 5 Prevention of Nutritional Deficiencies: Childhood is a critical period for preventing and addressing nutritional deficiencies. Common deficiencies in children include iron, vitamin D, calcium, and vitamin A. These deficiencies can lead to anaemia, weak bones, poor growth, impaired vision, and compromised immune function. A well-rounded diet with a variety of nutrient-rich foods can help prevent these deficiencies.

1. 6 Establishing Healthy Eating Habits: Childhood is a formative period for developing lifelong eating habits. Introducing a wide range of nutritious foods, including fruits, vegetables, whole grains, lean proteins, and dairy products, helps children develop a diverse palate and obtain essential nutrients. Encouraging regular family meals and limiting the consumption of processed foods, sugary snacks, and beverages is important for establishing healthy eating patterns.

1. 7 Prevention of Childhood Obesity: Proper nutrition plays a vital role in preventing childhood obesity. Balanced meals, portion control, and limiting the intake of sugary and high-fat foods can help maintain a healthy weight. Encouraging regular physical activity and minimizing sedentary behaviours are also crucial for preventing obesity and promoting overall health.

In summary, nutrition during childhood is fundamental for growth, development, cognitive function, immune health, and establishing lifelong healthy eating habits. Providing a balanced diet that meets all nutritional needs is essential for supporting children's well-being and maximizing their potential.

6.2.3 NEEDS AND OBJECTIVES:

Nutrition during childhood plays a crucial role in ensuring proper growth, development, and overall health of a children. The needs and objectives of nutrition during childhood are multifaceted and encompass several key aspects.

2. 1 Growth and Development: Adequate nutrition is essential for supporting optimal physical growth and development during childhood. Children require proper nutrients, including proteins, carbohydrates, fats, vitamins, and minerals, to support the bone development, muscle growth, and overall body maturation.

2. 2 Energy and Nutrient Requirements: Children have higher energy and nutrient requirements compared to adults due to their rapid growth and development. Meeting these requirements is crucial for ensuring optimal cognitive function, physical activity, and immune system functioning.

2. 3 Brain Development: The early years of childhood are critical for brain development. Proper nutrition, especially adequate intake of key nutrients like omega-3 fatty acids, iron, zinc, choline,

and vitamins, supports cognitive development, memory, learning abilities, and overall brain health.

2. 4 Immune Function: A well-balanced diet rich in essential nutrients, such as vitamins A, C, E, and zinc, helps strengthen the immune system in children. Good nutrition reduces the risk of infections and supports faster recovery from illnesses.

2. 5 Prevention of Nutrient Deficiencies: Childhood is a period of vulnerability to nutrient deficiencies. Proper nutrition helps to prevent deficiencies of key nutrients like iron, vitamin D, calcium, and iodine, which can lead to conditions such as anaemia, rickets, poor bone health, and impaired cognitive development.

2. 6 Establishing Healthy Eating Habits: Childhood is an opportune time to establish healthy eating habits that can have a lasting impact on a child's dietary patterns and health outcomes throughout life. Encouraging the consumption of a variety of fruits, vegetables, whole grains, lean proteins, and limiting the intake of added sugars, unhealthy fats, and processed foods can promote long-term health.

2. 7 Prevention of Chronic Diseases: Adequate nutrition during childhood can help prevent or reduce the risk of chronic diseases later in life. For example, a diet rich in fruits, vegetables, and whole grains, along with regular physical activity, can lower the risk of obesity, type 2 diabetes, cardiovascular diseases, and certain cancers.

2. 8 Healthy Weight Management: Childhood obesity is a growing concern worldwide. Promoting a balanced diet, portion control, and regular physical activity can help children maintain a healthy weight, reduce the risk of obesity-related health issues, and foster a positive body image.

2. 9 Development of Healthy Eating Behaviours: Encouraging a positive relationship with food, promoting mindful eating, and teaching children about the importance of nutrition and food choices, that can help them develop healthy eating behaviours and make informed dietary decisions.

2. 10 Overall Health and Well-being: Good nutrition during childhood contributes to overall health and well-being, including improved energy levels, concentration, mood, and better physical, mental, and emotional health.

It's important to note that specific nutrition needs and objectives may vary depending on the age of the child, individual requirements, cultural considerations, and any existing health conditions. Consulting a healthcare professional or registered dietitian can provide personalized guidance and support for optimizing nutrition during childhood.

6.2.4 NUTRIENT REQUIREMENT:

The nutrient requirements during childhood vary depending on the age of the child and their individual needs.

TABLE 4: SUMMARY OF RDA FOR INDIANS (CHILDREN)- 2020

Age Group	Category of work	Body Wt (kg)	Protein (g/d)	CHO (g/d)	Cal cium (mg/ d)	Magne sium (mg /d)	Iron (mg/ d)	Zinc (mg /d)	Iodine (µg/ day)	Thiamine (mg /d)	Ribo flavin (mg /d)	Niacin (mg /d)	Vit B6 (mg/ d)	Folate (µg /d)	Vit B12 (µg/ d)	Vit C (mg/ d)	Vit A (µg/ d)	Vit D (IU/ d)
Children	1-3y	11.7	11.3	130	500	135	8	3.0	90	0.7	0.9	7	0.9	110	1.2	27	390	
	4-6y	18.3	15.9	130	550	155	11	4.5	120	0.9	1.3	9	1.2	135	1.2	32	510	600
	7-9 y	25.3	23.3	130	650	215	15	5.9	120	1.1	1.6	11	1.5	170	2.5	43	630	

Let us study a

general overview of the key nutrients and their requirements during childhood:

3. 1 Energy: Children require an adequate amount of energy to support their growth, physical activity, and metabolic needs. Energy requirements vary based on age, gender, body size, and activity level. It is important to provide a balanced diet that meets their energy needs to ensure healthy growth and development. For 1-3 year children energy = 1010 kcal/day, for 4-6y energy

=1360kcal/day and for 7-9 year energy needs are 1700kcal/day.

3. 2 Carbohydrates: Carbohydrates are the primary source of energy for children. They provide fuel for physical activity and brain function. The recommended intake of carbohydrates for children is around 45-65% of total daily calories, with a focus on complex carbohydrates such as whole grains, fruits, vegetables, and legumes.

3. 3 Protein: Protein is essential for growth, tissue repair, and the production of enzymes and hormones. The recommended daily protein intake for children varies based on age, but a general guideline is around 0.95 grams of protein per kilogram of body weight. Good sources of protein include lean meats, poultry, fish, eggs, dairy products, legumes, and nuts.

3. 4 Fats: Healthy fats are important for children's growth, brain development, and the absorption of fat-soluble vitamins. It is recommended that 25-35% of total daily calories come from fats, with a focus on unsaturated fats found in sources like avocados, nuts, seeds, fatty fish, and vegetable oils. Limiting saturated and trans fats is important for heart health.

3. 5 Vitamins and Minerals: Children require a wide range of vitamins and minerals for their overall health and development. Some key nutrients include:

3. 5. i) Calcium: Essential for bone and teeth development. Good sources include milk, yogurt, cheese, leafy green vegetables, and fortified plant-based milk alternatives(500-650mg/day).

3. 5. ii) Iron: Important for the production of red blood cells and cognitive development. Good sources include lean meats, poultry, fish, fortified cereals, legumes, and dark leafy greens (8-15mg/day).

3. 5. iii) Vitamin D: Necessary for bone health and calcium absorption. It can be obtained from sunlight exposure and dietary sources such as fortified milk, fatty fish, and egg yolks(600 IU/day).

3. 5. iv) Vitamin C: Important for immune function and iron absorption. Citrus fruits, strawberries, tomatoes, and leafy greens are good sources (27-43 mg/day).

3. 5. v) B Vitamins: Play a significant role in energy metabolism and cognitive function. They can be found in whole grains, meat, poultry, fish, eggs, dairy products, legumes, and leafy greens (1.2-2.5 µg/day).

It's important to note that these recommendations are general guidelines, and individual needs may vary. Additionally, specific nutrient requirements may be influenced by factors such as growth spurts, activity levels, dietary restrictions, and any underlying health conditions. Consulting a healthcare professional or registered dietitian can provide tailored advice based on a child's specific needs.

6. 2. 4 DIET PATTERN:

Establishing a healthy and balanced diet pattern during childhood is crucial for promoting optimal growth, development, and lifelong health. Following are some notes on the key aspects of a healthy diet pattern for children:

4. 1 Variety of Foods: Encourage a wide variety of foods from different food groups to provide a range of essential nutrients. It includes fruits, vegetables, whole grains, lean proteins, and dairy or dairy alternatives in the diet. Introduce different types and colours of fruits and vegetables to ensure a diverse nutrient intake.

4. 2 Fruits and Vegetables: Aim for a minimum of five servings of fruits and vegetables per day. Include a mix of fresh, frozen, and canned options, but prioritize fresh or frozen when possible. Provide a range of colours to ensure a diverse nutrient profile (e. g. , red, orange, green, purple).

4. 3 Whole Grains: Choose whole grain options like whole wheat bread, brown rice, quinoa, oats, and whole grain cereals. Avoid refined grains and products with added sugars, such as white bread, white rice, and sugary cereals.

4. 4 Lean Proteins: Include lean protein sources such as poultry, fish, lean meats, eggs, legumes, and plant-based proteins like tofu and tempeh. Limit the consumption of processed meats and opt for healthier cooking methods like grilling, baking, or steaming.

4. 5 Dairy or Dairy Alternatives: Include calcium-rich foods like milk, yogurt, and cheese in the diet. Choose low-fat or fat-free options for children over the age of two, unless advised by a healthcare professional. If lactose intolerant or following a vegan diet, select fortified plant-based milk alternatives like soy milk or almond milk.

4. 6 Healthy Fats: Include sources of healthy fats in moderation, such as avocados, nuts, seeds, and vegetable oils like olive oil or canola oil. Limit saturated fats found in fatty meats, full-fat dairy products, and fried foods. Avoid trans fats, often found in processed and fried foods.

4. 7 Hydration: Encourage drinking an adequate amount of water throughout the day. Limit sugary beverages like sodas, fruit juices, and sports drinks. Avoid excessive consumption of caffeinated beverages.

4. 8 Limit Added Sugars and Salt: Minimize the intake of foods and drinks with added sugars, such as candies, cookies, sugary cereals, and sweetened beverages. Limit the use of salt and avoid adding extra salt to meals in place of it encourage the use of herbs and spices to add flavour.

4. 9 Portion Sizes: Teach children about appropriate portion sizes to prevent overeating and promote mindful eating. Use smaller plates and bowls to help control portion sizes. Encourage children to listen to their body's hunger and fullness cues.

4. 10 Family Meals and Role Modelling: Encourage regular family meals as it promotes healthy eating habits and positive food associations. Be a role model by demonstrating healthy eating behaviours and enjoying a variety of nutritious foods.

4. 11 Snacks: Offer healthy snack options like fruits, vegetables with dip, yogurt, nuts, or whole grain crackers. Limit the consumption of sugary snacks, chips, and processed snack foods.

4. 12 Meal Timing: Encourage regular meals and snacks throughout the day to provide sustained energy and support growth and development.

Aim for three main meals (breakfast, lunch, and dinner) with scheduled snack times in between. Remember that individual dietary needs may vary, and it's important to consider any specific dietary restrictions, allergies, or cultural preferences.

6. 2. 5 FEEDING PATTERN:

The feeding pattern during childhood refers to the approach and practices employed by parents or caregivers when it comes to feeding a child. It involves various aspects, including meal frequency, portion sizes, mealtime structure, food choices, and the development of healthy eating behaviours.

Let us now study the feeding pattern during childhood:

5. 1 Responsive Feeding: Responsive feeding involves recognizing and responding to a child's hunger and fullness cues. Parents and caregivers should pay attention to the child's appetite and offer food when the child is hungry, and stop feeding when the child indicates fullness. This approach helps children develop self-regulation of their food intake and promotes a healthy relationship with food.

5. 2 Meal Frequency: Depending on the age of the child, aim for three regular meals and two to

three scheduled snacks throughout the day. Offer a balanced meal pattern with a variety of food groups to ensure adequate nutrient intake. Establish consistent meal and snack times to provide structure and help regulate hunger and satiety cues.

5. 3 Portion Sizes: Provide age-appropriate portion sizes that consider the child's nutritional needs and developmental stage. Provide small and manageable portions, especially for younger children, and allow the child to ask for more if still hungry. Avoid pressuring the child to finish all the food on the plate and instead encourage them to listen to their internal hunger and fullness cues.

5. 4 Mealtime Structure: Create a positive and relaxed mealtime environment. Establish regular mealtime routines and rituals, such as sitting together as a family and avoiding distractions like screens or electronic devices. Encourage conversation and social interaction during meals, promoting a positive and enjoyable eating experience.

5. 5 Food Choices: Offer a variety of nutrient-dense foods from all food groups, including fruits, vegetables, whole grains, lean proteins, and dairy or dairy alternatives. Introduce new foods gradually, and repeatedly expose the child to different flavors, textures, and tastes. Encourage the consumption of minimally processed or whole foods and limit the intake of sugary, salty, and highly processed foods.

5. 6 Role Modelling: Parents and caregivers are a positive role models if they practice healthy eating behaviour by themselves. Eat meals with the child and demonstrate enjoyment of a variety of nutritious foods. Avoid using food as a reward or punishment and instead focus on promoting a balanced and varied diet.

5. 7 Encouraging Autonomy: Support the child's autonomy in food choices and feeding themselves, according to their developmental stage. Offer age-appropriate foods that the child can handle and allow them to self-feed as much as possible. Encourage the child to try new foods, but respect their preferences and avoid forcing or pressuring them to eat.

5. 8 Managing Picky Eating: Picky eating is common during childhood, and it's important to approach it with patience and understanding. Offer a variety of foods, including familiar and new options, and provide repeated exposure to increase acceptance. Avoid making separate meals or catering to every preference, as this may reinforce picky eating behaviour.

5. 9 Communication and Support: Maintain open and positive communication about food and eating. Encourage the child to express their food preferences and provide opportunities for them to be involved in meal planning and preparation. Seek professional advice if there are concerns about the child's growth, nutrient intake, or feeding difficulties.

5. 10 Special Considerations: Consider any specific dietary restrictions, allergies, or cultural preferences when planning meals for the child. Consult a healthcare professional or registered dietitian for guidance if the child has unique nutritional needs or medical conditions.

It's important to note that every child is unique, and their feeding pattern may vary. Parents and caregivers should adapt these guidelines to meet the individual needs and preferences of the child, while also ensuring a balanced and nutritious diet.

6. 2. 6 FACTORS AFFECTING DIET PLANNING:

Several factors can influence diet planning during childhood. Understanding these factors is important for creating a well-rounded and tailored approach to meet a child's nutritional needs. The following are some key factors that can affect diet planning during childhood.

6. 1 Age and Developmental Stage: The nutritional requirements of children vary depending on their age and developmental stage. Infants have specific dietary needs, such as breastfeeding or

formula feeding, while older children require a wider variety of solid foods to meet their nutritional needs.

6. 2 Growth and Development: The rapid growth and development during childhood require adequate nutrition to support physical, cognitive, and emotional development. The diet should provide essential nutrients, including proteins, carbohydrates, fats, vitamins, minerals, and water, in appropriate quantities to meet the child's growth requirements.

6. 3 Individual Nutritional Needs: Each child has unique nutritional needs influenced by factors such as genetics, metabolism, activity level, and existing health conditions. Some children may require modified diets to address specific nutritional deficiencies, food allergies, intolerances, or chronic conditions like diabetes or celiac disease.

6. 4 Cultural and Ethnic Background: Cultural and ethnic backgrounds can influence dietary preferences, food choices, and mealtime practices. Considering cultural traditions and incorporating familiar foods and flavors can help promote acceptance and adherence to a healthy diet.

6. 5 Family and Household Dynamics: The family environment plays a significant role in shaping a child's eating habits and dietary choices. Parental modelling, family mealtime routines, and the availability of nutritious foods at home all influence a child's diet. Socioeconomic factors can also impact access to a variety of foods and resources for healthy eating.

6. 6 Food Availability and Accessibility: The availability of different types of foods, both at home and in the community, can influence a child's dietary choices. Access to grocery stores, farmers' markets, and the affordability of nutritious foods can impact the variety and quality of a child's diet.

6. 7 Peer and Social Influences: Peers and social environments, such as school or social gatherings, can influence a child's food choices and eating behaviours. The influence of friends, classmates, and media exposure to marketing of unhealthy foods can impact dietary preferences.

6. 8 Parental Attitudes and Feeding Practices: Parental attitudes towards food, eating behaviours, and feeding practices can shape a child's eating habits. Encouraging a positive food environment, practicing responsive feeding, and promoting a balanced approach to eating are essential for fostering healthy dietary habits.

6. 9 Media and Advertising: Media exposure, including television, internet, and advertisements, can shape a child's food preferences and influence their dietary choices. Marketing of unhealthy foods and beverages can impact a child's desire for and consumption of these products.

6. 10 Nutritional Education and Knowledge: The level of nutritional education and knowledge among parents and caregivers can impact their ability to plan and provide a healthy diet for their child. Increasing nutritional literacy through resources, workshops, and access to professional guidance can support informed decision-making.

It's important to consider these factors when planning a child's diet to ensure it meets their individual needs, preferences, and cultural context. Consulting with a healthcare professional or registered dietitian can provide personalized guidance and support in navigating these factors and developing an appropriate nutrition plan for a child.

6. 2. 7 NUTRITION PROBLEMS DURING CHILDHOOD

Nutritional problems in childhood can arise due to various factors such as inadequate dietary intake, poor food choices, socioeconomic factors, cultural practices, and underlying health conditions. These problems can have significant short-term and long-term impacts on a child's growth, development, and overall health.

Following are the common nutritional problems of childhood:

7. 1 Malnutrition: Malnutrition refers to both undernutrition and overnutrition. Undernutrition occurs when a child does not receive adequate nutrients, calories, and essential micronutrients for proper growth and development.

7. 2 Protein-energy malnutrition (PEM): Insufficient intake of calories and protein, leading to stunted growth, weight loss, weakened immune system, and delayed cognitive development.

7. 3 Micronutrient deficiencies: Lack of specific vitamins and minerals (e. g. , iron, vitamin A, iodine, zinc) leading to anaemia, vision problems, impaired cognitive function, and compromised immune function.

7. 3. i) Iron Deficiency Anaemia: Iron deficiency anaemia is a common nutritional problem in childhood. Inadequate intake of dietary iron or poor iron absorption can lead to low iron stores and reduced production of red blood cells. Symptoms include fatigue, weakness, pale skin, poor concentration, and compromised immune function. Iron-rich foods like lean meats, poultry, fish, legumes, and fortified cereals should be included in the child's diet.

7. 3. ii) Vitamin D Deficiency: Vitamin D deficiency is prevalent in childhood, especially in areas with limited sunlight exposure or dietary sources. Insufficient vitamin D intake or inadequate synthesis from sunlight can lead to impaired bone health, increased risk of infections, and other health problems. Dietary sources of vitamin D include fatty fish, fortified dairy products, and supplementation which may be necessary in some cases.

7. 4 Childhood obesity: Overnutrition occurs when a child consumes excessive calories, often from unhealthy, energy-dense foods. Excessive body fat accumulation occurs due to a high-calorie, low-nutrient diet, sedentary lifestyle, and genetic factors. It increases the risk of chronic diseases such as diabetes, cardiovascular disease, and certain cancers.

7. 5 Dental Caries (Tooth Decay): Poor oral hygiene and excessive consumption of sugary foods and beverages contribute to dental caries in children. Frequent exposure to sugars can lead to the production of acids by bacteria in the mouth, resulting in tooth decay. Encouraging regular tooth brushing, limiting sugary snacks and drinks, and promoting dental check-ups are important preventive measures.

7. 6 Food Allergies and Intolerances: Food allergies and intolerances can affect children, causing adverse reactions to specific foods. Common food allergens include milk, eggs, peanuts, tree nuts, soy, wheat, fish, and shellfish. Allergies can cause mild to severe symptoms, including digestive issues, skin rashes, respiratory problems, and anaphylaxis.

Intolerances, such as lactose intolerance, can lead to digestive symptoms like bloating, diarrhoea, and abdominal pain. Identification and avoidance of specific allergens or intolerant foods are crucial for managing these conditions.

7. 7 Eating Disorders: Eating disorders, such as anorexia nervosa, bulimia nervosa, and binge-eating disorder, can develop during childhood or adolescence. These disorders are characterized by disturbed eating behaviours, negative body image, and significant physical and psychological consequences. Early identification, intervention, and appropriate psychological and nutritional support are essential for the treatment and prevention of long-term complications.

7. 8 Dietary Deficiencies and Imbalances: Inadequate intake or imbalances of specific nutrients can impact a child's health. For example, insufficient intake of fruits and vegetables can lead to deficiencies in vitamins, minerals, and fiber. Imbalances in macronutrients (carbohydrates, proteins, fats) or excessive consumption of processed foods can contribute to poor nutrient quality and

compromised health.

7. 9 Dehydration: Insufficient fluid intake and dehydration can occur in children, especially during hot weather or periods of increased physical activity. Dehydration can impair physical and cognitive performance, leading to constipation, and affecting overall well-being. Encouraging regular water consumption and providing access to fluids is crucial for maintaining proper hydration.

7. 10 Socioeconomic Factors: Socioeconomic factors, such as poverty and food insecurity, can contribute to nutritional problems. Limited access to nutritious foods, reliance on inexpensive but less nutritious options, and inadequate knowledge about healthy eating can affect a child's diet. Programs that address food insecurity, improve access to healthy foods, and provide nutrition education which will help in mitigating these challenges.

7. 11 Cultural and Dietary Practices: Cultural practices and dietary preferences can influence a child's nutritional status. Traditional diets may lack essential nutrients or include excessive amounts of certain foods. Balancing cultural preferences with the need for a diverse and nutrient-rich diet is important for optimal health. Addressing these nutritional problems requires a multi-faceted approach involving healthcare professionals, parents, caregivers, educators, and policymakers. Strategies include promoting breastfeeding, ensuring access to a diverse and nutrient-rich diet, nutrition education, regular health check-ups, and early intervention for identified issues.

6.2.8 LET US SUM UP

In this unit, the critical aspects of nutrition during infancy and childhood is explored, the unique nutritional needs at each stage of development was emphasized. We began with an overview of infant nutrition, highlighting its objectives and the importance of fulfilling specific nutrient requirements to support rapid growth and development. The unit discussed the dietary patterns and feeding methods suitable for infants, along with the factors influencing diet planning during infancy. Similarly, for childhood, we examined the nutritional needs and objectives that cater to the physical and cognitive development of children. The nutrient requirements, recommended dietary patterns, and appropriate feeding practices for children were outlined, along with the factors affecting diet planning. Additionally, we addressed common nutritional problems encountered during childhood and strategies to mitigate them. By understanding these aspects, students can better appreciate the role of balanced nutrition in promoting overall health and development during these crucial life stages.

6. 2. 9 CHECK YOUR PROGRESS

Short Questions

1. What is the primary objective of nutrition during infancy?
2. Name two key nutrients required for growth during childhood?
3. Mention any two factors affecting the diet planning for children.
4. What is the recommended duration for exclusive breastfeeding?
5. Define the term "weaning. "

Long Questions

1. Explain the nutritional needs and objectives during infancy and early childhood.
2. Discuss the nutrient requirements and diet patterns for school-aged children.
3. Describe the feeding patterns suitable for infants during the first year of life.

4. Analyze the factors influencing diet planning for children at different stages of growth.
5. Elaborate on the transition from exclusive breastfeeding to a family diet and its challenges.

UNIT-7 :NUTRITION DURING ADOLESCENCE, ADULthood AND OLD AGE

7. 1 Introduction

7. 2 Adolescence

7. 3. 0 Biological Development

7. 3. 1 Puberty

7. 3. 2 Growth Spurt

7. 3. 3 Reproduction Related Changes

7. 3. 4 Cognitive Development

7. 3. 5 Social Development

7. 4 Needs and Objectives

7. 5. 0 Nutrient Requirement

7. 5. 1 Diet Pattern

7. 5. 2 Factors Affecting Diet Planning

7. 6 Nutritional Problems of Adolescent

7. 7. 0 Adulthood

7. 7. 1 Stages of Adulthood

7. 8 Nutrient Requirements

7. 8. 1 Diet Pattern

7. 8. 2 Factors Affecting Diet Planning

7. 9 Old Age

7. 9. 1 Aging Process

7. 9. 2 Changes in Body Composition and Energy Balance

7. 9. 3 Biological Changes

7. 9. 4 Digestive Function

7. 9. 5 Needs and Objectives

7. 9. 6 Nutrient Requirement

7. 10 Diet Pattern

7. 10. 1 Factors Affecting Diet Planning

7. 10. 2 Nutritional Problems in Old Age

7. 11 Let Us Sum Up

7. 12 Check Your Progress

7. 1 INTRODUCTION

In the previous unit, we studied about nutritional needs for fitness and sport at different ages. We learnt how nutritional needs change for different sports at various age group.

The nutritional needs keep on changing throughout life depending upon the various phases of life. In this unit we will learn about the nutritional disorder and nutritional requirements at different age groups.

5. 1. 1 Objectives

- Describe the stages of adolescent, adulthood and old age.
- The nutrient requirement and dietary intakes for the adolescent, adulthood and old age.
- Understand the diet pattern, feeding pattern at adolescent, adulthood and old age.
- List and understand the different eating disorder of adolescence.
- Comprehend the nutritional problems of old age persons.

7.2 ADOLESCENCE

Adolescence is a period of rapid growth learning and development. Adolescence is a phase that extends from the onset of puberty until full growth is reached. According to WHO, adolescent is the phase of life between childhood and adulthood, from the age 10-19 years. It is an important phase of human life cycle. During adolescence the foundation of good health is laid.

Adolescence (from Latin word adolescere mean “mature”) is a transitional stage of physical and psychological development that generally occurs during the puberty to adulthood. Adolescence is associated with teenage years in which physical, psychological and cultural expression may begin early or later.

7.3 BIOLOGICAL DEVELOPMENT

7.3.1 Puberty

Puberty is a stage of rapid growth and development, culminating in sexual maturity, diet and exercise. The age of onset of puberty is 12 years for boys and 11 years for girls and it is mainly influenced by heredity, although environmental factors like diet and exercise also influence puberty. The most important changes that happened during puberty are in height, weight, body composition, circulatory and respiratory system. Hormones play a vital role in body during puberty. All the changes during puberty are influenced by hormones. Other physical changes are facial hairs in males, development of curved breast and prominent hips in females.

7.3.2 Growth Spurt

The growth spurt during adolescence is an increase in height and weight because of release of growth hormones, thyroid hormone and androgens. In females, the development is related with general body growth at adolescence. Other important physical changes during puberty are distribution of fat and muscles as muscle growth is faster in boys than in girls, although both gender experience rapid muscle growth.

7.3.3 Reproduction related changes

In females, changes in the primary sexual characteristics involve growth of the uterus, vagina and other aspect of the reproductive system. During puberty, menstruation begins in males, primary sexual characteristics are directly related to sex organs.

Secondary sexual characteristics are deepening of voice, facial and body hair, roughing of skin and

increase in development of sweat glands.

7. 3. 4 Cognitive development

During adolescence cognitive development also happens rapidly. Adolescence is a stage where the thoughts become more of abstract form, the egocentric thoughts decrease where the individuals think more logically and in wider perspective. There is a development of abstract thinking during adolescence. This is one of the most notable parts of cognitive development.

7. 3. 5 Social development

Adolescence is a stage where an individual develops the identity. During these years a person discovers who they are. The two main aspects of identity development are self-clarity and self-esteem. Choices made during adolescent years will influence in later years of life thus self-awareness and self-control is vital for better decision later in life. Self-concept is also developed during adolescence. It is an ability of a person to have opinion and belief that are defined confidently, consistent and stable in adolescence; there is a greater awareness of self, other and their thoughts and judgment, the ability to think about abstract future possibilities and to consider multiple possibilities.

7. 4 NEEDS AND OBJECTIVES

Since the adolescent age is an age of rapid growth and development thus the nutritional objective should focus on the all-round development.

- Provide necessary nutrient to meet the demands of physical and cognitive growth and development.
- Provide adequate stores for illness in future.
- Provide adequate stores for pregnancy in females.

7. 5. NUTRIENT REQUIREMENT

During adolescence the requirement for the nutrient increases as there is increase in growth and development and the RDA is given by ICMR, NIN-2020 as shown in table below. The RDA is calculated for the children till age 9 years. From 10 years onwards the RDA is computed separately for boys and girls. The boys and girls are divided into 3 categories i. e. 10-12 years, 13-15 years, and 16-18 years as given in table. The nutritional requirement for other nutrients is listed in table given below:

ICMR recommendation for adolescent boys and girls-2020

Let us study the nutrient requirement in details

Energy

The metabolic demands increase during adolescence and calorie intake also increases in boys as there is higher need of calories in boys than in girls. The peak calorie intake appears to parallel the adolescent growth spurt which is increasing until 16 years of age and then decreasing by 19 years. Although needs vary as girls consumes less calories than boys. Boys at the age of 10-12 years needs 2220 kcal/d while at the same age girls require 2060 kcal/day. The energy requirement increases with age for both the boys and girls to meet the requirement for growth and for future use.

Protein

Protein is an important nutrient for the development of muscle mass in both genders especially in

boys. The protein intake is calculated as 1 g/kg body weight. The protein intake is almost similar for both boys and girls up to the age of 10-12 years which is 32. 0(g/d) and 33. 0 (g/d). There is difference in protein requirement at the age group of 13-15 years which is 45. 0(g/d) for boys and 43. 0(g/d) for girls. Similarly at the age group of 16-18 years the requirement is 55. 0(g/d) for boys and 46. 0 (g/d) for girls. The protein requirement depends upon the age as the age increases the protein requirement also increases. Protein requirement is directly depending upon the peak energy requirement. Therefore, it is important to take proper amount of energy and protein at the time adolescence to avoid condition such as malnutrition.

Fat

The recommended fat intake is less than 35g/d for boys and for girls it should be 45g/day at the age of 10-12 years. The food should be low in fat especially saturated fat and trans fat. This requirement increases with age for boys and decreases in case of girls.

The essential fatty acid helps in relaxing muscles of the uterus and reduces menstrual cramps. It also reduces inflammation of mucous membrane of the uterus. It reduces abdominal pain before, during and after menstrual periods.

Minerals

During adolescence the calcium requirement is same in both the genders that is 850 (mg/d) where magnesium requirement is 240(mg/d) for boys and 250(mg/d) for girls at the age group of 10-12years. At the age of 16-18 years the requirement is 1050(mg/d) which is same for both the genders.

Iron is an important mineral especially for the females as at the adolescence the girls have their periods. Iron is important for the synthesis of hemoglobin. If the iron is lost during the menstruation it will result in iron deficiency anemia. Therefore, the iron requirement is higher for the females as compared to the males.

Vitamins

Vitamins are important micronutrient which is required to carry functions of the body. During adolescence the vitamin D is important for the skeletal growth and bones formation in both the genders. The requirement is around 600(IU/D) in both the genders. Vitamin A requirement is calculated from the growth curve interpolation data.

Trace elements

Iodine is required in highest amount during adolescence which is same for both the genders, 140(µg) iodized salt consumption is recommended at adolescence for the prevention of goiter and other related issues. Now we know which nutrients are required for the optimal growth in adolescence, we will now study the diet pattern and factors affecting the diet planning for the adolescent.

7. 5. 1 DIET PATTERN

The diet pattern of adolescent should be based on the following factors

- Starvation
- Fad diets

Adolescents are prone to starvation or inanition and fad diets. It is normal for girls to gain weight during adolescence thus they start starving to lose weight which is very harmful for their health in long term as they will have their menstrual cycle during this time. If they will not follow a balanced diet, they may have conditions such as anemia or other nutritional deficiencies.

Other than starvation adolescent also follows fad diets or binge eating. Both the conditions are bad for long-term health for both the genders. Eating pattern of adolescent is characterized by skipping meals, eating junk, eating outside food, eating at odd hours, snacking, following specific diets and frequently changing their food habits.

7. 5. 2 FACTORS AFFECTING DIET PLANNING

There are certain factors which need to be kept in mind while planning diet for the adolescent.

- The diet should be well balanced to meet the increased nutritional needs during this crucial period.
- Iron rich foods should be included to prevent blood related deficiencies.
- The food should be tasty and colorful.
- Skipping meals should be avoided as the adolescents are prone to skipping meals to follow certain diets.
- Small and frequent meals should be kept while planning a diet to meet the increased demands of energy and other nutrients.
- Fruits and vegetables should be included in the diet plan.
- Calcium rich food should be included in diet especially for the girls to meet the increased demand for bone formation.
- Carbonated drinks should be avoided
- Home based food is recommended.
- Calorie and protein rich food should be taken to ensure proper growth and to avoid malnutrition related to protein and calorie intake.
- Proper exercise and physical activity should be recommended to avoid weight gain.
- Binge eating or emotional eating should be avoided.

7. 6 NUTRITIONAL PROBLEMS OF ADOLESCENT

In the last chapter the nutrient requirement is explained, now we will learn about the nutritional disorders of adolescent life.

Obesity

Obesity means excessive accumulation of fat in the adipose tissue, located especially in waist, hips and breast with increased body weight by 10% or more above standard reference weight for the age, sex and height. Adolescent is a age at which the kids consumes high amount of junk food which is high in saturated fat and calories. Physical activity is also very low at this stage which when combined with poor dietary habits results in obesity. Low physical activity may be due to high screen time.

Obesity may be due to family habits, genetic, emotional stress and hormonal imbalance. Generally, the adolescent leads a very sedentary life style which is the major cause of increased body weight. Obesity can be managed by high physical activity with combination of low-calorie food. Parents should encourage their kids to have foods at home. Family and parents play an important role in kid's healthy dietary habits, encouraging physical activity and handling emotional health as well.

Bulimia nervosa

It is a disorder where a person eats a large amount of food to the extent that the person loses their control over the eating habit. Then the person vomits or uses laxative to get rid of the food eaten in order to avoid gaining weight. This disorder is very common during adolescence. Desire to have an ideal body weight is the major cause of bulimia nervosa. Proper nutrition guidance, nutrition awareness education and counseling are the ways to control this disorder.

Anorexia nervosa

This is also an eating disorder in which people become obsessed about weight and what they eat. Adolescents are really conscious about their body weight and how they look, thus they eat less, do starvation in order to maintain weight below average body weight. They also do abnormally high exercise so to lose body weight. This may lead to yellowing of skin, palpitations, fatigue, laziness, depression, social withdrawal, emotional withdrawal, weakness. Proper nutrition education, nutrition awareness and family support will help in handling this disorder.

Binge Eating disorder

It is a disorder where a person eats a large amount of food frequently and is unable to stop eating. This is very common in females. The reasons can be emotional instability, hormonal changes, stress, depression and low self-esteem.

Anemia (iron deficiency anemia)

Iron deficiency anemia is the most common type of anemia especially at the adolescent age group. Anemia is a condition where there is insufficient amount of iron present in the blood. Iron is required to make red blood cells. This causes the hemoglobin level to fall below average. The symptoms of iron deficiency anemia are fatigue, weakness, menstruation related irregularities, irritability, pale skin, dizziness and shortness of breath.

For all the eating disorders proper nutritional education, awareness, guidance and counseling are most important factors. Establishing weight goal is important and supplementation with multivitamin is an essential part of diet therapy so to avoid deficiencies. Nutrition guidelines should be given with proper meal plans. Underlying psychological issues should be addressed as most of the eating disorders are caused by the psychological problems at this age.

7.7 ADULTHOOD

Different types of nutrients are needed by human beings to perform different functions. Adulthood is the stage which starts at the end of adolescence and continues till the end of life. Maximum growth takes place till the 30 years of age. The human body will reach maximum cardiac output during adulthood, specifically between the age of 20 and 30 years. Bone and muscle mass also reach to optimal levels, physical activity improves muscle strength, endurance and tone. Besides physical activity, nutrition also plays an important role in maintaining good health through adulthood.

7.7.1 STAGES OF ADULTHOOD

Adulthood is divided into 3 stages

- Early adulthood
- Middle adulthood
- Late adulthood

Early adulthood

Early adulthood is the period starting from the age of 18 years and continues till 30 years. At this

stage the people are physically fit and healthy. People complete their education and starts looking for job and career opportunities. Cognitive development at this stage is characterized by impulsive behavior and growth in epistemic understanding. Sometimes people get married at this stage and starts family life.

Middle adulthood

Middle adulthood is marked by mid 30s to mid 60s. During this time aging becomes visible with wrinkles, graying of hairs, and health problems. At this stage people meet their career goals and childrens grow up.

Late adulthood or old age

Late adulthood begins from mid 60s till death. During this time physical ability declines and most individuals retire. People spend their time with grandchildren, get involved in their hobbies, and spend time with their peer group of similar interest. Mental health decline during old age along with social and physical health.

7.8 NUTRIENT REQUIREMENTS

Reference Indian adult man and women

Reference man is between 18-29 years of age and weights 60 kg with a height of 1.75 with BMI of 20.3 and is free from diseases and physically fit for active work; on each working day he is engaged in 8 hours of occupation which usually involves moderate activity, while when not at work they mostly spend 8 hours in bed, 4-6 hours in sitting and moving, 2 hours in walking and in active recreation or household duties.

Reference women is between 18-29 years of age, non-pregnant, non lactating and weights 55 kg with a height of 1.61 m and BMI of 21.2, free from disease and physically fit for active work, on each working day they are engaged in 8 hours of occupation which usually involves moderate activity, while when not at work they spends 8 hours in bed, 4-6 hours in sitting and moving, 2 hours in walking and in active recreation and household duties.

An important factor which determines the energy needs is the nature and duration of physical activity, whether moderate or heavy. For those occupation that involves heavy work, allowance have to be higher than those who are sedentary or engaged in moderate work. The recommended dietary allowances for adult man and women are given in table below.

ICMR recommended dietary allowances for an adult man and women-2020

Nutrients	Man	Man	Man	Women	Women	Women
	Sedentary	Moderate	Heavy	Sedentary	Moderate	Heavy
Energy(kcal)	2110	2710	3470	1660	2130	2720
Protein (g)	54	54	54	46	46	46
Fat (g)	25	30	40	20	25	30
Calcium(mg)	1000	1000	1000	1000	1000	1000
Iron (mg)	19	19	19	29	29	29

Vitamin A	1000	1000	1000	840	840	840
Thiamine (mg)	1. 4	1. 8	2. 3	1. 4	1. 7	2. 2
Riboflavin(mg)	2. 0	2. 5	3. 0	1. 9	2. 4	3. 1
Niacin (mg)	14	18	23	11	14	18
Vitamin D	600	600	600	800	800	800
Vitamin C (mg)	80	80	80	65	65	65
Dietary folate(µg)	300	300	300	220	220	220
Vitamin B12(µg)	2. 2	2. 2	2. 2	2. 2	2. 2	2. 2
Magnesium (mg)	440	440	440	370	370	370
Zinc(mg)	17	17	17	13. 2	13. 2	13. 2

SOURCES: ICMR 2020

Energy

Energy requirement is based on the recommended dietary allowances. One important criteria for calculating nutritional needs of adults is the nature and duration of physical activity and lifestyle (sedentary, moderate and heavy). RDA needs to be higher for the people who are doing heavy work or moderate work as compared to the sedentary worker.

Protein

The RDA for Indian women and men is calculated at 1 g/kg body weight keeping in mind a diet consisting of proteins of mixed vegetable sources. Physiologically 0. 5g/kg body weight of protein is the average protein needed by the Indian adult, when consuming a diet comprising of good quality protein like eggs and milk. Nitrogen losses have to be kept in mind as well, so in order to compensate for those losses, low protein sources and variability in diet is required with the allowances of 1g/kg body weight.

Protein energy ratio

While intake of adequate calories is essential for adults, it is also important to consider the percentage of calories being derived from protein. The protein energy ratio is a useful tool which indicates the ratio of calories from proteins of total calories in the diet. The protein energy ratio (PE) is not a statement of requirement to be used as such. Rather, the PE ratio signifies one aspect of the nutritional quality of foods or diets.

The recommended or safe protein energy ratio is that concentration of dietary protein, expressed as a proportion of total energy, that will ensure the protein needs of almost all individual of a particular age, sex, physiological state, and activity level group, which will be only met when those persons have consumed sufficient amount of food to meet their individual energy needs.

Calculations of recommended P/E ratios

The following points need to be kept in mind when calculating protein energy ratio:

Protein requirement: These vary with age, sex, and physiological state (i. e. pregnancy and lactation)

Protein quality and digestibility: Protein recommendations are based on the intake of animal protein with the reference value of 100% for digestibility and a pattern of indispensable amino acids where none is limiting. Diets that include mostly vegetables or mixers of vegetable and animal foods have lower protein digestibility and their chemical composition may or may not have limiting amino acids.

Energy requirements: In addition to age, sex and physiological state, energy requirements are strongly influenced by the physical activity associated with lifestyle and occupation. This must be considered to define the total energy component of the P/E ratio.

Fat

Fat is essential for the normal functioning of body. Fats provide a good source of energy and enable the body to absorb, circulate and store the fat-soluble vitamins like A, D, E and K. Recommended total fat for men should not exceed more than 25 g/day for sedentary worker and women should not have more than 20 g/day for sedentary worker. A higher level of fat is recommended as per the activity level of a person as it provides energy density and palatability in the diet. At all levels of calorie intake, invisible fat furnishes about 9% energy and visible fat 10%.

Saturated fatty acids, cis-monosaturated fatty acids, proteins and cholesterol can increase essential fatty acids requirement. It would appear practical to choose the visible or cooking fat from unsaturated vegetable oils. Blend of the two or more vegetable oil ensures the recommended intake of fatty acids.

Minerals

The recommended intake of calcium for the Indian as per the RDA is 1000mg/d, for both the genders. It is suggested that the Ca: P in the diet should be 1: 1. Hence the phosphorus requirement is same for both genders that is 1000mg. During infancy the Ca: P ratio is suggested is 1: 15. During childhood and adolescence the bone mass increases and peaks between 20- 30 years. Peak bone mass is influenced by calcium intake. Other factors like age, sex, genetic factors, hormonal status and exercise also influenced. After the age of 30 years, the rate of withdrawal exceeds the rate of deposit. Therefore, establishing healthy bone mass in childhood and early adulthood is important.

Average iron loss due to menstruation each month in women is 0. 6mg per day. Due to this iron loss women need 4mg/day iron more than men to meet daily needs and keep iron reserves healthy. The iron requirement for men is 19mg/day while for women is 29mg/day is recommended. With iron one must ensure to take good amount of vitamin C to ensure proper absorption of iron in the body. The requirement of zinc in men 17mg/day is recommended and for women it is suggested to take around 13. 2mg/day.

Vitamins

Vitamin A requirement for men and women is 1000ug/day and 840ug/day. The requirement of vitamin D is same for both the men and women is 600 UI/d. The requirement for the vitamin B12 is 2. 2 µg/d which is same for both the genders. The requirement of vitamin C is 80mg/day for men and for women it is 65mg /d which is sufficient to meet the daily need as there is also a loss of vitamin during cooking. Vitamin E requirement is 7-10mg tocopherol/day depending on the vegetable oil used in cooking.

7. 8. 1 DIET PATTERN

Needs and objective

- The diet should be helpful in maintaining adequate level of energy.
- Balancing different food groups and consumption of food in right proportion.
- The diet should provide adequate amount of calories to maintain a healthy weight.
- Depending on the activity level, metabolism and exercise level.
- The diet should be planned as per the economic level.

7. 8. 2 FACTORS AFFECTING DIET PLANNING

- Nutritional requirement: the diet should be planned as per the nutritional requirement based on the age, sex, activity level, physiological status and exercise or physical activity.
- Budget: the diet should be planned considering the economic status of the individual.
- Food preferences: this is a very important factor for the diet planning especially for adults. The diet should be planned as per any diet restrictions and preferences of an individual.
- Portion control, balance and moderation: balancing the food intake of various kinds ensure the consumption of different nutrients which helps in maintaining good health. Portion size ensures the maintaining of healthy weight.
- Requirement of fats: fats are essential for good health. Fat provides energy and helps in the absorption of fat-soluble vitamins(A, D, E and K). It is important to include fat in prescribed amount as too much of fats is harmful for health and can cause heart related medical issue.

7. 9 OLD AGE

Old age is the last phase of human life cyclic with age limit from 65 and older. If the earlier stages have been nutritionally fulfilling then this age will be easy to handle otherwise it will be challenging to function at an old age. Old people may have a sense of wholeness and completeness, or they may increasingly withdraw from life.

Most of the families in India live in a joint family. In such environment the old people have a sense of belonging. The old people are enriched with life's experiences which they share with others thus it is a mutually rewarding relationship.

7. 9. 1 AGING PROCESS

As the person ages, there is a change in body composition, physical performance, and functioning of organ system. The degree of changes may be different for different individual. Most of the bodily functions decline as a part of the aging process. These changes are influenced with lifestyle, surroundings and other factors.

7. 9. 2 CHANGES IN BODY COMPOSITION AND ENERGY BALANCE

The body undergoes many changes as a person advances in age. There is drastic change in body composition during aging which includes loss of lean body mass (LBM), bone mass, body water and there is a relative increase in body fat. The fat mass is redistributed from mainly subcutaneous to abdominal fat. The reduction in size and strength of skeletal muscle results in decrease in lean body mass. The loss in lean body mass and change in fat mass is associated with sarcopenia, a term derived from the Greek words *sarx* (flesh) and *penia* (poverty). Rosenberg (1997) given this term, as he wanted the medical people to recognize this aging condition in an early stage to diminish the negative impact on mobility and mortality. With age related metabolic diseases and with the presence of individual handicaps, sarcopenia often coincides with decline of physical activity. Moreover, due to diminished maximum oxygen intake and muscle fibre atrophy, a greater physical

effort for the same task is required by the older people. As a result, older people will reduce physical activity further and have lower energy expenditure. Weight loss in old age should be prevented, because it increases the risk of progressive malnutrition, micronutrient deficiency, nutrition related diseases, and is related to increased mortality.

Bone mass density will start to decrease from the age of 35-40 years onwards, especially in women due to menopause the decrease in bone mass accelerates. The reduction in bone mass is also associated with osteoporotic fractures. Osteoporosis is a bone disease and inadequacies of the nutrients calcium and vitamin D are related to a decline in bone density and to fractures. In old age vitamin D deficiency is seen due to less synthesis in the skin. As well as due to less exposure to sunlight. Dehydration is another issue related with old age. Reduced renal function, loss of thirst sensors, fear of incontinence may result in less fluid intake. Dehydration results in constipation, faecal impaction, cognitive impairment and even death.

7. 9. 3 BIOLOGICAL CHANGES

Human growth is continuously declining throughout the lifespan. Every individual ages differently depending on resources and genetic makeup. During the entire middle and older adulthood, there is slow loss of functioning cells with reduced cell metabolism which starts at the age of 30, as a result the bodily system and functions gradually lose their reserves. It accelerates in later years of life. For example, the liver loses 40% of its weight, kidney and lungs lose about 10% of its weight. A major contribution factor in this loss is due to lack of exercise.

Hormonal changes during aging process have major effects on old age. The most common is reduction in insulin production which results in elevated blood glucose levels and diabetes. Changes in body composition are due to decrease in growth hormone and the sex hormone estrogen and testosterone. For females, a major change in body is due to menopause. This is the end of child bearing age, thus it results in cessation of estrogen and progesterone production by ovaries. There is a change in female's life due to hormonal changes in old age. Due to these changes, there is change in lean body mass and increase in body fat which increases the risk of disease.

7. 9. 4 DIGESTIVE FUNCTION

With the advancement of age, it is seen that there is decline in digestive and absorptive functions of the body. The main reason is diminished; altered and missing taste perception. As the age advances it may cause change in oral cavity (loss of teeth, dental issues, and saliva production) and changes in neuronal fibres that are connected to the brain. Along with these changes on olfactory system (smell), the overall sensory perception of food declines. Individual are not able to distinguish between taste and smell. Taste issues may relate to the olfactory disorders. All these issues of smell and taste in old age causes malnutrition along with difficulty in swallowing the food and neurological disorders.

The most important change in the old age is the decrease in production of gastric juices especially in old people as they are having atrophic gastritis. Atrophy of stomach mucosa is also very common in old people above 60 years. Due to this problem, there is reduction in acid secretion, intrinsic factors and pepsin, which reduces the bioavailability of vitamin B 12, calcium, iron, and folate.

7. 9. 5 NEEDS AND OBJECTIVES

It is a challenge to meet the nutritional needs of an elderly person when having the various constraints. Some of the constraints are as follows:

- Injuries
- Reduction in the abilities of sight, smell, taste, and hearing.

- Constipation
- Fixed income so it makes hard to afford healthy foods.
- Dental medical issues.

The objectives and requirement of diet for old age are as follows:

- To delay the effect of aging and diseases
- To aid in the management of the physical, psychological and psychosocial changes associated with old age.

7.9.6 NUTRIENT REQUIREMENT

The nutrient requirements during old age are:

Energy

It is seen that after the age of 35, the basal metabolic rate reduces significantly as a result there is an increase in fat mass and reduced active tissue mass and muscle mass. There is reduction in physical activity which also affects the energy needs. Some studies have found that even when controlling for fat free mass, basal metabolic rate is 5% lower in older compared to younger adults. The basal metabolic rate reduces more rapidly after 40 years in males and 50 years in females. Basal metabolic rate, which accounts for 50-70% of total energy expenditure, is thought to decrease about 1-2% per decade. When a person reaches 20 years old, daily expenditure decreases about 150 calories per decade.

Older people require fewer calories due to various reasons. Firstly, the biological need for energy is reduced. Secondly, they have less muscle mass, which decreases the number of calories needed to maintain their weight because fat requires fewer calories to maintain the muscle. Thirdly, they have slower metabolism, so it takes them longer to burn the calories as they consume through their daily activities. Lastly, the physical activity is reduced requiring fewer calories.

Carbohydrate

As we know that the calorie requirement is reduced in old age thus the carbohydrate requirement is also reduced. The aim should be to supply the complex carbohydrate rather than the simple carbohydrate to help the body with a good fibrous diet to facilitate bowel movement and avoid constipation which is a common problem in old age. The vegetables such as green leafy vegetables and pulses should be given in moderation as they may cause flatulence. Simple sugars, processed food and refined food items must be avoided as they add too many calories. It is necessary to provide 50 % of calories from the carbohydrates.

Protein

As the age progresses there is decrease in skeletal tissue mass. This results in reduction of protein stores provided by skeletal muscles and may be inadequate to meet the needs of protein synthesis. Thus, the dietary protein intake is important to meet the essential needs.

Although the calorie requirement is reduced, the protein requirement of 1g/kg body weight remains the same as adults. Despite the needs remain unchanged the older people consumes less protein due to reduction in appetite, flatulence and poor digestibility. Focus should be on consumption of good quality protein, which is easy to prepare and eat. Egg is a good source of good quality protein but it should be given in small amount. Tofu, paneer and cheese are all good sources of protein. Nuts and oilseeds like almonds, walnuts, pistachios, peanuts, melon seeds and sesame seeds should also be included in diet. Other types of milk like almond milk and soy milk should be included other than

cow's milk as out of total calorie needs 11-12% should be from protein.

Fats

As there is reduced calorie intake, the fat requirement in diet is also reduced. It is important to provide good fats, PUFA and MUFA, rather than saturated fats. Essential fatty acids are important part of the diet. Older people who take good amount of omega 3 fatty acids have better visual activity, omega 3 fatty acids help in conditions such as hair loss, impairment of vision, improper digestion and gas, poor kidney function, tissue inflammation, osteoarthritis, painful joints, and muscles and mental depression. Flax seeds, almonds, sunflower seeds, melon seeds, olives, coconut oil, seafood, cod liver oil tablets are good options. Saturated fat, processed foods and fried foods should be avoided.

Minerals

All the minerals are important for the proper functioning of body but calcium, iron, zinc, sodium and magnesium play an important role.

Calcium needs during old age increases. The bones become weaker as one grows old because the skeleton loses calcium. Women lose more calcium from their bones in the 5-10 years around the age of menopause. Both men and women lose calcium from their bones as they grow old. A diet high in calcium cannot reverse the age-related bone loss, it can slow the process. Consuming a diet high in calcium in early years of life helps with calcium stores in body as well as it lays a strong foundation of strong teeth and bones. Women above 50 years of age who are not taking estrogen therapy, requires high calcium to compensate the increased depletion of calcium which results in demineralization of bone, osteomalacia, and osteoporosis. Good levels of vitamin D are required by the body to absorb calcium. Milk and dairy products are good source of calcium in old age.

Zinc

Good availability of zinc can help in preventing the skin, nerves, and body system issues. It is studied that zinc deficiency results in delayed wound healing, reduced taste, sensation, loss in appetite, hair loss and anorexia. Lean meats and sea foods are good source of zinc. Grains and other protein rich plants sources like beans and legumes have good amount of zinc. Care should be taken to include supplementation or zinc rich food in the diet.

Iron

The transportation of oxygen in the body is done by iron. It helps the immune system to fight against diseases. Iron deficiency has been observed in the elderly due to low intake of iron, faulty absorption of iron, low bio availability of iron from food sources, blood loss as a result of chronic diseases/and a reduced non-haem iron absorption as a consequence of achlorhydria of atrophic gastritis. Increase consumption of iron rich food such as amaranth, nuts, dry fruits, fortified pulses, cereals, whole grain, enriched breads and iron fortified salt. 30 mg/day iron is sufficient for normal elderly while an additional 10mg/day helps in cases of anemia.

Sodium

It is important to control the levels of sodium in diet at every phase of life. A balanced diet should be consisting of natural food and less processed food. Table salt should be avoided and low salt should be added in food while cooking. The aim is to control high blood pressure and prevent other diseases.

Other important criteria about sodium, which is becoming very common with old age is low sodium levels (hyponatremia), which occurs when there is low sodium level in blood or when there is too much water in the blood. Risk factors that may aggravate the condition are taking diuretics which

increase urination. Thus, it is crucial to maintain the sodium levels in diet.

Magnesium

Inadequate magnesium intake is common, especially in older people. It is necessary for the body for the maintenance of muscles and nerves, and in controlling blood pressure and maintaining a steady heart rhythm. It is involved in cellular energy metabolism in the mitochondria, and abundant chemical energy is required for the physical exertion. Magnesium is necessary for the maintaining optimal muscle performance and exercise tolerance in postmenopausal women. Nuts and seeds, beans, meats, whole grains, fruits and dairy products are good source of magnesium.

Water

Water is an important factor for old people as well as young people. Water helps in digestion and absorption of nutrients from food. Consumption of inadequate water and water loss through the body has been associated with increased incidence of dehydration among old people. It is studied that amount of body water decreases by approximately 15% (about 6L) between the ages of 20 and 80 years. Due to this the body become susceptible to dehydration from the loss of small amount of body water. Inadequate intake of water or loss of water among elderly may cause the problem of constipation. It is therefore very important to ensure adequate intake of water in elderly. Adding alternate of water such as buttermilk, fresh lime water, coconut water, kanji, lassi, smoothies, fresh sweet lime juice, juices, ginger drink can help in ensuring good amount of fluid intake.

Fibre

Fibre rich diet is essential especially among elderly people. Fibre stimulates peristalsis. There is great enthusiasm to encourage the consumption of fibre containing food but any inclusion should be gradual otherwise there will be bowel discomfort, distension and flatulence. Fibre helps in reducing the cholesterol which results in reduction of incidence of atherosclerosis. Although, careful addition of fibre should be done as excess of fibre may interfere in iron absorption of some trace elements.

To increase the fibre in diet tender vegetables, fruits will make the easier passage of food to pass down the intestinal tract. Rough fibre, bran and mature vegetables are not recommended for elderly.

7. 10 DIET PATTERN

- Analyze food habits carefully. Learn about attitudes, situations, and desires of the older people. Nutritional needs can be met with a variety of foods, so to make suggestions in a practical, realistic and supportive manner.
- Never moralize, never say, “Eat this because it is good for you”. This approach has a little value for anyone, especially for those struggling to maintain their personal integrity and self-esteem in a youth oriented, age fearing culture that largely separate their age.
- Encourage food variety, mix new food with familiar comfort food. New tastes and seasoning often encourages appetite and increase interest in eating. Many people believe that the bland diet is good for the elderly people but it is not. The decreased taste sensitivity of aging necessitates added attention to the variety and seasoning. Smaller amount of food and more frequent meals encourage better nutrition.
- Food rich in proteins, vitamins and minerals should be included.
- Empty calories should be avoided.
- Fat helps in weight gain. Saturated fat should be avoided.
- Soft and well-cooked food should be given.

- Food should have less amount of sodium.
- Fried and processed food should be avoided.
- Caffeine containing beverages should be given in limited amount.
- Adequate amount of fluid should be given to prevent constipation and dehydration.
- Should include high fibre diet like green leafy vegetables.
- 2-3 servings of low-fat milk should be included in the diet.
- Vegetables and fruits are excellent source of anti-oxidants thus it should be given in good amount.
- Consumption of omega 3 fatty acids may help in reducing hair loss, impairment of vision, improper digestion and tissue inflammation.
- Food should be less salty and less spicy.

7. 10. 1 FACTORS AFFECTING DIET PLANNING

There are some factors which affect the diet planning and these factors should be kept in mind while planning the diet for the elderly

Physical factors

A reduced appetite is one of the important factor which should be kept in mind while planning diet. The food should be appetizing and colourful. The elderly face dental issue therefore the food should be soft and easy to chew. Muscle mass tends to decrease with age. This can result in lower strength, energy, mobility and balance. This can make shopping, cooking and eating difficult. Taste and smell tend to decline with age. Foods may not taste same causing lower food intake. Saliva tends to decrease with age this will result in making food dry and difficult to swallow causing lower food intake.

Emotional factors

Depression is a problem for many older adults. Loss of social contacts, retirement, and loss of family and friends can cause depression. Poor diet can cause depression which can lead to lack of interest in shopping, cooking and eating.

Medication factors

Medicine can reduce the appetite in many ways. Some medicines can cause alteration in taste buds, nausea and depression.

Economic factors

Elderly have limited funds which can result in less money for food and transportation. This may affect the quality of the food.

7. 10. 3 NUTRITIONAL PROBLEMS IN OLD AGE

The old people are at the risk of nutrition related problems due to economic factors, poor dentition, reduced mobility, depression, loneliness, aging tissue and inadequate food consumption. Particularly women are at the higher risk of developing problems such as osteoporosis and anemia.

Osteoporosis

Osteoporosis is a condition where there is loss of bone mineral density due to increase in osteoclast, bone resorption activity and associated decrease in osteoblast mediated bone formation. This is

generalized bone disease characterized by low bone density and micro architectural deterioration of bone tissues. The risk of osteoporosis increases with age. At the time of menopause, women lose bone quickly for several years. In males the loss of bone mass is lower but at the age of 35 – 70 years, men and women loses the bone mass at the same rate. Porous and weak bones are a common concern as women age, making them vulnerable to fractures. After menopause the loss of bone mass is accelerated thus making women more prone to fractures, injuries and joint ailments.

The cause of osteoporosis is age related changes such as decreased estrogen production associated with menopause. The decline in circulating 17-beta-estradiol is the predominant factor in acceleration bone mass loss and begins after the menopause and continuous for 6-8 years. Decreased intestinal absorption of calcium and production of vitamin D, reduced physical activity and increased parathyroid hormone secretion may also cause osteoporosis. Less intake of protein may also result in osteoporosis in old age people.

Men also suffer with osteoporosis. Risk factors for men are as follows

- Low levels of testosterone
- Family history of osteoporosis
- Low levels of calcium and vitamin D
- Excessive consumption of alcohol
- Low physical activity
- Smoking
- Prone to frequent fractures

Good bone health may be achieved with increasing bone mass at maturity, by preventing subsequent bone loss, or by restoring bone mineral density. Proper intake of calcium, exposure to vitamin D and physical activity especially in young age.

Obesity

Due to reduced physical activity and high calorie diet, the body gains weight and the person becomes obese. In the 50 – 60 years of age the reduction in energy expenditure contributes to the increase in body fat. The hormonal fluctuations also contribute to the accumulation of fat. Aging is associated with decrease in growth hormone secretions, reduced responsiveness to thyroid hormone, declines in testosterone and resistance to leptin, which could contribute to obesity. There is a strong link between the genetic makeup and obesity. Several hundred genes are involved in body weight regulation. Only a few single gene mutations can cause obesity. Single gene mutations are typically associated with massive obesity.

Apart from genetic reasons there are several environmental factors, lifestyle factors and sociological factors which are responsible for the obesity. These factors play an important role in maintaining the quality of life. Lifestyle is of utmost importance, cooking and eating at home rather than eating out, waking up on time and doing workout or some kind of physical activity plays a vital role in having a healthy weight. Other than these factors their medical conditions which are associated with obesity such as polycystic ovarian syndrome, depression, hypothyroidism, cushing's syndrome bone related issue, joint pain and decreased physical activity. Obesity is an important risk factor for the cardiovascular diseases. It increases the risk of coronary heart diseases in those younger than 50 years. Varicose veins and peripheral edema occur more commonly in obese than normal weight people. Cardiac abnormalities such as cor pulmonale and lymphedema may occur with gross obesity. Maintaining healthy weight, avoidance of calorie rich diet, avoidance of processed

food, including green leafy vegetables and fruits and incorporating exercise in daily routine will help in preventing the obesity in old age.

Constipation

Constipation is described as passage of firm and hard pellet like stools frequently and taking long interval to expel with difficulty. Excretion of faecal matter is the last part of digestion process. The food travels through colon where water is absorbed and the remaining food is transformed into waste or stools. If too much water is absorbed by the colon will result in hard dry stool and constipation. In constipation there may be less than 3 motions per week or painful defecation. In old age as there is less fluid intake, this contributes to constipation. Apart from this reason there is less mobility, reduced physical activity and low or no exercise, all these factors result in constipation. Insufficient emptying of bowel may lead to headache, coated tongue, bad breath, malaise and lack of appetite. Constipation can be prevented by taking adequate amount of fluid, intake of regular meals, doing exercise or physical activity and eating high fibre diet such as green leafy vegetables.

Anemia

Anemia in old age is a matter of great concern and is an independent risk factor for many conditions. The degree of anemia in old age contributes to morbidity and mortality and has a significant effect on quality of life. Anemia is explained as a feeling of weakness, fatigue, pale skin, body ache, breathlessness, under eye circle, dizziness, lack of energy, lethargy, anxiety and sleeplessness. The WHO defines anemia as haemoglobin (Hb) less than 130g/L in men, Hb less than 120g/L in non-pregnant women, less than 110g/L in pregnant women. Haemoglobin declines with age. The reason for low hemoglobin is due to underlying disease such as bleeding, malnutrition, cancer and infectious diseases. Pernicious anemia is seen chiefly in middle age and elderly (women aged between 45-65 years). Prevention can be done by taking adequate amount of iron rich diet, iron supplements, and vitamin C rich foods. The diet should include green leafy vegetables, meat, egg, curd and vitamin C rich food.

Malnutrition

The problem of malnutrition is a very common nutritional problem during old age. The reasons are less mobility, low economic status, cumulative effects of chronic diseases, multiple medications, social isolation and lack of knowledge for adequate preparation of meals. According to studies showed that the average daily intake of majority of nutrients such as calcium, iron, vitamin A, thiamine, riboflavin and vitamin C were below the recommended levels as evidenced by the low levels of consumption of protective foods. Deficiencies in elderly are at higher level as there is low consumption of food and diseases conditions.

Dehydration

As the age progresses it produces the physiological changes that can affect fluid balance in the older adults, increasing the risk for dehydration. Total body water decreases with age, which means a decreased fluid reserve. There is a high risk of dehydration among elderly because of the kidney's decreased ability to concentrate urine, altered thirst sensation, decreased renin activity and aldosterone secretion. Relative renal resistance to vasopressin changes in functional status, delirium and dementia, medication side effects and mobility disorders also results in dehydration. Elders need at least 2-3 liters of fluid per day. Fruits and fruit juice, buttermilk, lime juice with salt in addition to water is recommended.

7. 11 LET US SUM UP

This unit started with the discussion regarding the adolescence and their age groups. The different changes which happened during adolescence is well explained. There are many major developments

during adolescence like puberty, cognitive development, reproductive related changes, social development and hormonal changes. We learned about the needs and objective of nutritional support in adolescence.

Then we learned regarding the dietary requirements during the adolescence. The energy and protein requirements are on peak during this period which is also important for the overall health. There is also requirement of minerals like iron which is essential for girls as adolescence is the period of menarche.

Then the problems of nutrition during adolescence is discussed. The adolescent is very conscious regarding weight gain therefore the adolescent tries to lose weight by following the fad diets or by starving which is not good for health in long term. Anorexia nervosa, obesity and bulimia are other nutritional related issues. In the next stage growth and adulthood is discussed. There are mainly 3 stages in adulthood and we gain an insight in the RDA for the nutrient requirement at this stage.

After adulthood, we discussed about the aging process, the last stage in human life cycle where the implications of the old age are explained. There are many changes which happen during old age like biological changes and emotional changes. The digestive system also gets influenced during old age. There is a specific diet pattern which needs to be followed in old age. A very important aspect that is the nutrient requirement during old age is also discussed.

Finally, the nutrition related problems in old age and major health issues like constipation, anemia, dehydration, malnutrition and obesity is discussed.

7.12 CHECK YOUR PROGRESS

1. Define adolescence? What is the age group of adolescence?

2. What are the major changes during adolescence?

3. What are the nutrient requirements during adolescence?

4. Define fad diets?

5. Which nutrients are important in the diet of the adolescent girls?

6. What are the factors which should be considered in diet planning?

7. What are the 3 stages of adulthood?

8. What is the energy, protein and fats requirement for the adults as per RDA 2020?

9. What are the needs and objectives of diet planning for adults?

10. Explain any two nutritional related diseases in old age?

11. What are the factors affecting the diet planning?

BLOCK-III

NUTRITION DURING DISORDERS AND DISEASES-I

INTRODUCTION

Nutrition during disorders and diseases involves tailoring dietary plans to manage and support the specific health needs and conditions of individuals. This can encompass various approaches, including dietary restrictions, therapeutic diets, and nutritional supplementation, depending on the diagnosis. The objectives are often to manage symptoms, reduce complications, and support overall health and well-being. Nutrition plays a critical role in the prevention, management, and treatment of various diseases and conditions, such as diabetes, heart disease, cancer, gastrointestinal disorders, and food allergies, among others. Dietary plans are typically developed by healthcare professionals, such as dietitians or doctors, to address the unique requirements of each patient's condition.

Nutrition during disorders and diseases is a critical component of medical care, as it can significantly impact the course of a condition, its symptoms, and the overall well-being of individuals.

Heart Disease: A heart-healthy diet aims to reduce the risk of heart disease or manage existing conditions like hypertension and high cholesterol. It typically involves reducing saturated and trans fats, limiting sodium intake, and increasing fiber-rich foods like fruits, vegetables, whole grains, and lean proteins.

Gastrointestinal Disorders: Conditions like irritable bowel syndrome (IBS), celiac disease, Crohn's disease, and diverticulitis may require specialized diets. This often involves identifying trigger foods and managing symptoms through dietary adjustments.

Kidney Disease: Managing protein, phosphorus, and potassium intake is vital for those with kidney disease. Depending on the stage of the disease, dietary protein may need to be restricted, and phosphorus and potassium intake should be limited.

Nutrition during disorders and diseases is highly individualized and should be guided by healthcare professionals, particularly registered dietitians or nutritionists. These experts consider the specific diagnosis, nutritional requirements, lifestyle, and personal preferences to develop tailored dietary plans that optimize health, manage symptoms, and improve the overall quality of life for individuals facing various health challenges.

Unit 8- Nutrition in hepatic (liver) problems is crucial for managing liver diseases such as cirrhosis, fatty liver disease, or hepatitis. Dietary recommendations typically include limiting sodium intake to manage fluid retention, moderating protein intake to reduce ammonia production, and avoiding alcohol to prevent further liver damage. Adequate calorie intake and a balanced diet are essential to prevent malnutrition and support overall liver function. Dietary plans should be tailored to the specific liver condition and may require ongoing monitoring and adjustments under the guidance of a healthcare professional.

Unit9- Nutrition in renal (kidney) diseases is vital for managing conditions like chronic kidney disease (CKD) or end-stage renal disease (ESRD). Key aspects include controlling protein, phosphorus, potassium, and sodium intake to reduce the burden on the kidneys and manage electrolyte balance. Adequate calorie intake and balanced nutrition are essential to prevent malnutrition. Specialized diets like the renal diet or hemodialysis diet are often prescribed, and fluid intake may be restricted to manage fluid retention. Nutrition plans are tailored to the specific stage of kidney disease and may require ongoing monitoring by a healthcare professional, typically a registered dietitian or nephrologist.

Unit10- Nutrition in gastrointestinal (GI) disturbances is crucial for managing conditions like irritable bowel syndrome (IBS), celiac disease, crohn's disease, or gastritis. Dietary approaches often involve identifying and avoiding trigger foods that exacerbate symptoms. Fiber intake may be adjusted based on the specific GI condition, and probiotics may be recommended to support gut health. For certain conditions like celiac disease, a strict gluten-free diet is essential. Overall, nutrition plays a central role in alleviating GI symptoms, promoting gut healing, and improving quality of life for individuals with these disorders.

Unit11- Nutrition in cardiovascular diseases focuses on reducing risk factors like high blood pressure, cholesterol levels, and excess weight to prevent heart disease. Key dietary strategies involve limiting saturated and trans fats, reducing sodium intake, increasing fiber-rich foods, and promoting a heart-healthy diet rich in fruits, vegetables, whole grains, and lean proteins. Additionally, omega-3 fatty acids from sources like fatty fish are encouraged for heart health. Adopting these dietary habits can help manage and prevent cardiovascular diseases while improving overall cardiovascular well-being.

Unit12- Nutrition in hormonal disturbances involves dietary adjustments to manage conditions influenced by hormonal imbalances, such as thyroid disorders, PCOS, and diabetes. These adjustments typically focus on controlling blood sugar levels, managing weight, and optimizing nutrient intake through a balanced diet tailored to each specific condition. Consultation with healthcare professionals, including endocrinologists and registered dietitians, is crucial to create effective and personalized nutrition plans for hormonal health.

Unit13- Nutrition in febrile (fever-inducing) conditions involves supporting the body's increased energy and nutrient needs during illness or infection. Adequate calorie intake, hydration, and maintaining nutrient balance are essential. Focus on easily digestible foods, such as broths, fruits, and vegetables, and prioritize fluid intake to prevent dehydration. While appetite may decrease during fever, it's crucial to provide essential nutrients to support the immune system's response and aid in recovery. Consultation with healthcare professionals may be necessary, especially in severe or prolonged febrile conditions.

Unit14- Nutrition for fitness and sport aims to optimize performance, enhance recovery, and support overall athletic well-being. It emphasizes a balanced diet that provides sufficient calories, macronutrients (carbohydrates, proteins, and fats), and micronutrients (vitamins and minerals) to meet the increased energy expenditure and muscle demands of physical activity. Timing of meals and snacks around workouts is important, as is staying well-hydrated. Athletes often benefit from consulting with sports nutritionists to create personalized nutrition plans that align with their specific training goals and dietary preferences.

UNIT-8 : WEIGHT MANAGEMENT

Structure

- 8. 1 Introduction
- 8. 2 Etiology of Obesity
- 8. 3 Theory of Obesity
- 8. 4 Role of Hormones in Regulation of Appetite and Body Weight
- 8. 5 Role of Enzyme in Obesity
- 8. 6 Assessment of Obesity
- 8. 7 Regional Distribution of Adipose Tissue in Men and Women
- 8. 8 Types of Obesity
- 8. 9 Problems Related to Obesity
- 8. 10 Concept Energy Balance for Weight Loss
- 8. 11 Treatment
 - 8. 11. 1 Diet Therapy
 - 8. 11. 2 Behavior Modification
 - 8. 11. 3 Physical Exercise
 - 8. 11. 4 Stress Management
 - 8. 11. 5 Weight Loss Surgery
- 8. 12 Diet for Underweight
- 8. 13 Etiology of Underweight
- 8. 14 Signs and Symptoms of Underweight
- 8. 15. Assessment of Underweight
- 8. 16 Consequences of Underweight
- 8. 17 Diet in Under Weight
- 8. 18 Feeding Pattern for Underweight
- 8. 19 Let Us Sum Up
- 8. 20 Check Your Progress

8. 1 INTRODUCTION

Weight management refers to the ongoing process of maintaining a healthy body weight within a desired range. Weight management is essential for overall health and well-being, as excess weight and underweight are associated with numerous health risks.

Obesity has emerged as a significant global health concern, with its prevalence reaching alarming levels in recent years. This persistent problem affects people of all ages, genders, and socioeconomic backgrounds, and its consequences extend beyond individual health to impact society as a whole. Obesity is characterized by excessive accumulation of body fat in adipose tissue leading to more

than 20% percent of the desirable weight. It may result from a combination of genetic, environmental, and lifestyle factors. In addition, obesity is associated with a wide range of chronic diseases and health complications, including cardiovascular diseases, type 2 diabetes, certain types of cancer, musculoskeletal disorders, and mental health issues. In other hand, overweight is a term used to describe a condition in which a person has a higher body weight is 10-20% than normal or healthy for their height and age.

The prevalence of obesity has shown a concerning upward trend worldwide. Sedentary lifestyles, poor dietary choices, and changes in food availability and consumption patterns have contributed to its rise. According to recent studies, more than 1.9 billion adults worldwide are classified as overweight, and over 650 million individuals are diagnosed as obese. These numbers highlight the urgent need for effective strategies to prevent and manage obesity on a global scale. Therefore, maintaining a healthy weight is crucial for reducing the risk of these chronic conditions and improving overall quality of life. It's important to note that weight management is not just about achieving a specific number on the scale but rather focusing on overall health and well-being. A combination of balanced eating, regular physical activity, and behavioral strategies is crucial step for weight management and reducing the risk of chronic diseases, and improve their overall quality of life. Weight management involves achieving and maintaining a weight that is appropriate for an individual's height, age, and gender, while also promoting overall health and well-being. Accurate and reliable measurement of obesity is crucial for its diagnosis, monitoring, and management. In this article, we will discuss different methods and techniques used for the measurement of obesity.

This shall learn about the prevalence, causes, consequences, and potential solutions to the obesity epidemic. By gaining a deeper understanding of obesity and its multifaceted nature, one can work towards implementing effective interventions and promoting healthier lifestyles to combat this growing global health challenge.

Expected Outcomes

After studying this unit, you will be able to:

- understand the cause and contributing factors of obesity and underweight
- identify the various method for assessment of obesity and underweight
- explain the role of hormones and enzymes in obesity
- describe the consequence and treatment of obesity and underweight

8.2 ETIOLOGY OF OBESITY

The etiology of obesity is complex and multifactorial, involving a combination of genetic, environmental, behavioral, and metabolic factors. Understanding the various factors that contribute to the development of obesity is crucial in developing effective prevention and management strategies. In this detailed explanation, each component of the etiology of obesity will be explored.

1. **Genetic Factors:** Genetic factors play a significant role in the development of obesity and it influences 50-70percent ofa person's chance of becoming fat more than another factor. Studies have shown that genes can influence a person's susceptibility to weight gain and their ability to maintain a healthy weight. Within families the chance is 80 percent if both parents are obese and50 percent if one parent is obese. Certain genetic variations can affect metabolism, appetite regulation, fat storage, and energy expenditure. For example, variations in the FTO (fat mass and obesity-associated) gene have been associated with increased body weight and obesity risk. However, it is important to note that genetic factors alone are not sufficient to cause obesity, and their influence is often modulated by environmental and

lifestyle factors.

2. **Socioeconomic Factors:** Socioeconomic status and access to resources can impact dietary choices and physical activity levels. Lower socioeconomic status is often associated with limited access to healthy foods, fewer opportunities for physical activity, and higher prevalence of obesity.
3. **Eating habits:** Eating habits play a significant role in the development and management of obesity. Unhealthy eating habits, such as consuming excessive calories, high-fat and sugary foods, and large portion sizes, can contribute to weight gain and obesity. Here are some ways in which eating habits can affect obesity:
 - i. *Caloric Intake:* Consuming more calories than the body needs on a regular basis promotes weight gain. Eating energy-dense foods that are high in calories but low in nutritional value, such as fast food, processed snacks, and sugary beverages, can contribute to excessive calorie intake and weight gain.
 - ii. *Portion Sizes:* Large portion sizes, especially when combined with energy-dense foods, can result in overconsumption of calories. Many restaurants and food establishments offer oversized servings, which can lead to a higher calorie intake without individuals realizing it. Portion control is essential for maintaining a healthy weight.
 - iii. *Eating Speed:* Eating too quickly can hinder the body's ability to register feelings of fullness and satiety. It takes time for the brain to receive signals from the stomach that it is satisfied. Eating too quickly can lead to overeating before the brain has a chance to recognize that enough food has been consumed.
 - iv. *Emotional Eating:* Many individuals turn to food for emotional comfort or as a way to cope with stress, anxiety, or other negative emotions. Emotional eating often involves consuming high-calorie, sugary, or fatty foods that provide temporary comfort but can contribute to weight gain over time.
 - v. *Snacking and Grazing:* Frequent snacking or grazing throughout the day, especially on unhealthy foods, can lead to excessive calorie intake. Mindless snacking, such as eating while watching TV or working, can result in consuming more calories than intended.
 - vi. *Lack of Nutrient-Dense Foods:* A diet lacking in nutrient-dense foods, such as fruits, vegetables, whole grains, and lean proteins, can contribute to obesity. These foods are rich in vitamins, minerals, and fiber, which support overall health and help regulate appetite and weight.
 - vii. *Eating Out and Fast-Food Consumption:* Regularly eating out or consuming fast food is often associated with higher calorie intake and poorer dietary quality. Fast food and restaurant meals tend to be high in calories, unhealthy fats, and added sugars, making them less conducive to weight management.
 - viii. *Food Processing:* Highly processed foods often contain added sugars, unhealthy fats, and artificial additives. These foods are typically calorie-dense but poor in nutrition, leading to excessive calorie consumption.
4. **Physical Activity and Sedentary Behavior:** Physical activity plays a crucial role in energy expenditure and weight management. Insufficient physical activity and high levels of sedentary behavior contribute to weight gain. Technological advancements, increased urbanization, and changes in occupational patterns have reduced physical activity levels. Sedentary behaviors, such as prolonged sitting, excessive screen time, and reduced physical

activity, contribute to an imbalance between energy intake and expenditure. Regular physical activity not only helps burn calories but also improves metabolic health, muscle mass, and overall well-being.

5. **Psychological Factors:** Psychological factors such as emotional eating, stress, anxiety and depression, can influence eating behaviors and contribute to the development of obesity. Certain components of food, such as carbohydrates, can temporarily increase the release of neurotransmitter “serotonin” in the brain, which may indirectly influence endorphin release. This can lead to overeating or the consumption of calorie-dense foods as a coping mechanism.
6. **Hormonal imbalances:** Hormonal imbalances, such as insulin resistance and leptin resistance, can disrupt appetite regulation, energy balance, and fat metabolism. For example, insulin resistance reduces the body's ability to respond to insulin, leading to elevated insulin levels and increased fat storage.

It is important to note that the interplay between these factors is highly complex and individualized. Each person's genetic makeup, environment, lifestyle choices, and underlying health conditions can influence their susceptibility to obesity. Furthermore, the impact of these factors can vary across different populations and demographics.

8.3 THEORY OF OBESITY

The theory of obesity involves various factors that contribute to the development and maintenance of excess body fat. While obesity is a complex condition influenced by genetic, environmental, and behavioral factors, several key theories help to explain its underlying mechanisms. Here are some prominent theories of obesity:

1. **Energy Balance Theory:** The energy balance theory states that obesity occurs when energy intake (calories consumed through food and beverages) exceeds energy expenditure (calories burned through physical activity and metabolism). When there is a chronic positive energy balance, with more calories consumed than burned, the excess energy is stored as fat, leading to weight gain and obesity.
2. **Fat cell Theory:** Obesity is the result of an abnormal accumulation of lipids (fat) within adipose tissue. The theory proposes that when a person gains weight, the existing fat cells in the body expand in size to store the excess energy as triglycerides. If the energy intake continues to exceed expenditure, the fat cells may reach their maximum capacity and become "overstuffed." In such cases, the body may start to generate new fat cells through a process called adipogenesis, further increasing the overall number of fat cells. The number of fat cells increases most rapidly during the growing years of late childhood and early puberty. Once the fat cells are formed, they have the ability to store and release fat as needed. They also secrete various hormones and signaling molecules, collectively known as adipokines, which regulate metabolism and contribute to the overall balance of energy homeostasis in the body.

Obese people have more fat cells than healthy-weight people; their fat cells are also larger. When energy intake exceeds expenditure, the fat cells accumulate triglycerides and expand in size. When the cells enlarge, they stimulate cell proliferation so that their numbers increase again. Thus, obesity may develop due to increase in number of fat cells (called *hyperplastic obesity*) and/or increase in size of fat cells (called *hypertrophic obesity*), or quite often both.

The fat cell theory suggests that having a higher number of fat cells predisposes individuals to store more fat which makes it more challenging for obese person to lose weight. People with extra fat cells tend to regain lost weight rapidly. In contrast, people with an average

number of increased fat cells may be more successful in maintaining weight loss and when their cells shrink, both cell size and number are normal. In addition, the expansion and multiplication of fat cells can contribute to the development of obesity and its associated health complications, such as insulin resistance, type 2 diabetes and cardiovascular disease.

3. **Set-Point Theory:** The set-point theory suggests that individuals have a genetically determined weight range or set-point, which the body strives to maintain. According to this theory, when body weight drops below the set-point, physiological mechanisms are activated to increase hunger, decrease metabolism, and conserve energy, promoting weight regain. Similarly, if body weight exceeds the set-point, the body tries to reduce hunger and increase metabolism to bring weight back to the set-point.
4. **Hormonal Imbalance Theory:** Hormones play a crucial role in regulating appetite, satiety, and metabolism. The hormonal imbalance theory proposes that disruptions in hormonal signaling, such as leptin resistance (a hormone that regulates appetite and energy expenditure) and dysregulation of other hormones like insulin, ghrelin, and cortisol which can contribute to obesity. These hormonal imbalances can affect hunger cues, satiety signals, and the body's ability to regulate energy balance.
5. **Gut Microbiota Theory:** Emerging research suggests that the composition and activity of the gut microbiota (the collection of microorganisms in the digestive tract) can influence body weight and metabolism. Alterations in the gut microbiota, such as a reduced diversity of beneficial bacteria, can lead to metabolic dysregulation, increased energy extraction from food, and inflammation, potentially contributing to weight gain and obesity.

It's important to note that these theories are not mutually exclusive, and multiple factors often interact to contribute to obesity. Genetic predisposition, environmental factors (such as obesogenic food environments and sedentary lifestyles), socioeconomic factors, psychological factors, and cultural influences also play a significant role in the development of obesity.

8.4 ROLE OF HORMONES IN REGULATION OF APPETITE AND BODY WEIGHT

Insulin and leptin are two important hormones involved in the endocrine regulation of appetite and body weight. Insulin and leptin function together to regulate appetite and body weight. Insulin helps control blood sugar levels and fat storage, while leptin provides feedback about energy stores and appetite. However, in conditions like insulin resistance and leptin resistance, these regulatory mechanisms can become dysregulated, leading to imbalances in appetite control and body weight regulation. Understanding the roles of insulin and leptin in the endocrine regulation of appetite and body weight is crucial for addressing issues related to weight management and obesity.

Here's an overview of their roles:

1. **Insulin:** Insulin is produced by the pancreas and plays a key role in regulating blood sugar levels. However, it also has important effects on appetite and body weight regulation. Insulin acts on various tissues, including the brain, adipose tissue, and liver. Its primary functions related to appetite and body weight are:
 - *Appetite Suppression:* Insulin helps to suppress appetite by acting on the hypothalamus, a region of the brain involved in the regulation of hunger and satiety. It signals the brain to decrease food intake and promotes a feeling of fullness after meal.
 - *Fat Storage:* Insulin promotes the uptake and storage of glucose and fatty acids in adipose tissue. It stimulates the conversion of excess glucose into triglycerides for storage as fat. In individuals with insulin resistance or high insulin levels, excessive fat storage can contribute to weight gain and obesity.

- *Metabolic Regulation:* Insulin plays a crucial role in regulating metabolism. It promotes glucose uptake by cells, stimulates protein synthesis, and inhibits the breakdown of stored glucose (glycogen) in the liver. By regulating glucose and energy metabolism, insulin helps to maintain stable blood sugar levels and influences energy balance.
1. **Leptin:** Leptin is a hormone produced primarily by adipose tissue (fat cells). It plays a critical role in the regulation of appetite, energy balance and thereby body weight. Therefore, it is regarded as a body weight regulatory hormone. It binds to a specific receptor in the brain and functions as a lipostat. It acts on the hypothalamus to control food intake and energy expenditure. The concentration of leptin in blood is usually proportional to the amount of stored fat. The main functions of leptin include:
 - *Appetite Regulation:* Leptin acts as a satiety hormone, signaling the brain that the body has sufficient energy stores and reducing appetite. It helps in regulating food intake by suppressing hunger and promoting a feeling of fullness after eating. When the fat stored in the adipose tissue is adequate, leptin levels are high. This signal restricts the feeding behavior and limits fat deposition. Leptin stimulates lipolysis and inhibits lipogenesis. Without sufficient leptin signaling, the brain does not receive the proper signals to suppress appetite and promote satiety.
 - *Energy Expenditure:* Leptin influences energy expenditure and plays an important role in the long-term regulation of energy balance. During starvation and weight loss, leptin production from adipose tissue decreases and promotes the utilization of stored fat as an energy source. It helps maintain energy balance by regulating the balance between energy intake and energy expenditure.
 - *Fat Mass Regulation:* Leptin levels are closely related to the amount of body fat. As fat cells increase in size and store more fat, they produce and release more leptin. Higher levels of leptin are typically associated with higher levels of body fat. Leptin acts as a feedback signal, providing information to the brain about the body's energy stores. When leptin levels are elevated, it indicates an adequate energy reserve, leading to a decrease in appetite and food intake. Conversely, lower levels of leptin can result from reduced fat stores and may lead to increased appetite and food intake.
 - *Effect of genetic deficiency of leptin:* Genetic deficiency of leptin, also known as congenital leptin deficiency, is a rare condition that can have a profound effect on appetite regulation, metabolism, and body weight. Individuals with genetic deficiency of leptin typically develop severe obesity from an early age. Any genetic defects in leptin or its receptor will lead to obesity.

Besides, there are other hormones also which affect the metabolism such as:

3. Growth hormone (GH): In obesity, there is often a decrease in growth hormone secretion and impaired GH signaling, leading to reduced GH levels in the bloodstream. The decrease in growth hormone levels contributes to the accumulation of body fat and decreased muscle mass, both of which are characteristic features of obesity. Growth hormone deficiency has been associated with increased visceral adiposity, insulin resistance, and dyslipidemia, all of which are risk factors for obesity-related complications.

4. Thyroid hormones: Thyroid hormones, primarily thyroxine (T4) and triiodothyronine (T3), are critical for regulating metabolism. They control the rate at which the body uses energy and affect various metabolic processes, including fat metabolism. However, it is important to note that low T3 syndrome is not a primary cause of obesity but rather a consequence of metabolic changes associated with excess weight.

8. 5 ROLE OF ENZYME IN OBESITY

Lipoprotein lipase (LPL) is an enzyme that plays a crucial role in the metabolism of lipids, particularly triglycerides. It is primarily found in adipose tissue, muscle tissue, and the lining of blood vessels. LPL functions to hydrolyze triglycerides from circulating lipoproteins, such as chylomicrons and very low-density lipoproteins (VLDLs), into free fatty acids and glycerol, which can then be taken up by cells and used for energy or storage.

In the context of obesity, the role of LPL becomes significant. LPL activity is generally higher in adipose tissue of individuals with obesity compared to those with normal weight. This increased LPL activity in adipose tissue promotes the uptake of fatty acids into fat cells, leading to enhanced fat storage. As a result, individuals with higher LPL activity in adipose tissue may be more prone to developing obesity or accumulating excess body fat. Gender differences have been observed in LPL activity, with women generally having higher LPL activity in adipose tissue compared to men. This higher LPL activity in women's adipose tissue contributes to their greater capacity for fat storage. It is believed that these gender differences in LPL activity are influenced by hormonal factors, such as estrogen and progesterone, which can increase LPL synthesis and activity. When it comes to weight loss, LPL activity can be modulated by changes in energy balance. Caloric restriction and weight loss interventions can lead to a decrease in LPL activity in adipose tissue. This reduction in LPL activity is thought to be a compensatory mechanism to conserve energy and limit the release of fatty acids during the period of energy deficit.

However, it's important to note that the relationship between LPL activity, gender, and weight loss is complex and can vary among individuals. While women may have higher LPL activity, it doesn't necessarily mean they will experience more difficulty in losing weight compared to men. Weight loss is influenced by multiple factors, including genetics, hormonal status, dietary habits, physical activity, and overall energy balance.

Moreover, LPL activity can be influenced by various factors, including genetic variations, hormones, adipokine secretion, and metabolic rate and dietary factors. Certain genetic variants of the LPL gene have been associated with increased LPL activity and a higher risk of obesity. Hormones like insulin and cortisol can stimulate LPL activity, while dietary factors such as high-fat diets can upregulate LPL expression. Therefore, focusing on a comprehensive approach that includes a balanced diet, regular physical activity, and behavioral modifications is essential for successful weight management, regardless of gender.

8. 6 ASSESSMENT OF OBESITY

Obesity is a complex and multifaceted health issue characterized by excessive body fat accumulation. It is a significant global public health concern due to its association with various chronic diseases, including cardiovascular diseases, type 2 diabetes, certain types of cancer, and musculoskeletal disorders.

1. **Body fat percentage:** It is a commonly used method for assessing obesity as it provides an indication of the proportion of body weight that is composed of fat. It's important to note that these ranges can vary depending on factors such as age, fitness level, and individual health considerations. Body fat assessment is an important component in assessing obesity because excess body fat is a major contributor to obesity. Various methods can be used to assess body fat, such as skinfold calipers, bioelectrical impedance analysis (BIA), dual-energy X-ray absorptiometry (DXA), air displacement plethysmography (ADP), hydrostatic weighing, and near-infrared interactance (NIR). These methods estimate the proportion of body weight that is composed of fat. Typically, higher body fat percentages indicate a higher risk of obesity-related health issues. The classification of body fat percentage may vary depending on age, sex, and

specific reference standards used, but generally, the categories for assessing obesity based on body fat percentage include:

- *Essential Fat*: This is the minimal amount of fat necessary for normal physiological functioning. It is typically higher in women due to reproductive and hormonal needs and ranges from around 10-13% for women and 2-5% for men.
- *Athletes or Fitness Level*: Athletes and individuals with a high level of physical fitness tend to have lower body fat percentages. For men, this range is usually around 6-15%, and for women, it is around 16-25%.
- *Average/Healthy Range*: This range is considered healthy for most individuals. For men, it is typically between 16-20%, and for women, it is between 22-33%.
- *Overweight*: Body fat percentages above the average/healthy range but below the obese range may be classified as overweight. This can vary, but generally, for men, it may be above 20% and for women, above 33%.
- *Obese*: Body fat percentages that fall within the obese range indicate a higher level of excess body fat and increased health risks. For men, this range is typically above 25%, and for women, above 35%.

Here's a breakdown of body fat percentage categories for both men and women in tabular form:

Table 8. 1: Body Fat Percentage for Adult

Category	Male	Female
Fitness	12-20%	20-30%
Borderline	21-25%	31-33%
Overweight	25-31%	33-39%
Obese	>32%	>39%

Body fat percentage can be measured by using various methods, including skinfold calipers, bioelectrical impedance, or dual-energy X-ray absorptiometry (DEXA). These methods estimate body fat by measuring different variables such as skinfold thickness, electrical conductivity, or X-ray absorption.

Body fat percentage varies depending on factors such as age, gender, and fitness level. However, generally:

- Men: $\geq 25\%$ body fat is considered obese
- Women: $\geq 32\%$ body fat is considered obese

While body fat percentage is a useful tool for assessing obesity, it should be interpreted in conjunction with other measures, such as BMI, waist circumference, and overall health status.

2. **Body Weight:** An adult weighing 10 percent more than the standard weight is over weight and 20 percent more is obese.

Table 8. 2: Body Weight Classification

Body weight excess to normal	Degree of obesity
25	Mild
50	Moderate
75	Severe
100	Very severe

3. **Body Mass Index (BMI):** Body Mass Index (BMI) is the most commonly used method for assessing obesity at the population level. It is calculated by dividing an individual's weight in kilograms by the square of their height in meters

$$\text{BMI} = \text{weight (kg)} / \text{height (m}^2\text{)}$$

The individuals classify according to BMI as underweight, normal weight, overweight, or obese.

Table 8. 3: Body Weight Classification According to BMI

Body Weight Classification	Body Mass Index (BMI) Range
Underweight	Less than 18. 5
Normal Weight	18. 5 - 24. 9
Overweight	25. 0 - 29. 9
Obesity	$\geq 30. 0$

Obesity is frequently subdivided into categories based on the body mass index (BMI) and the level of adiposity (body fat percentage). These categories provide a way to classify individuals based on the severity of their obesity. The commonly used categories include:

Table 8. 4: Classification of obesity according to BMI

Obesity Category	BMI Range (kg/m ²)
Grade1 Obesity	30. 0 - 34. 9
Grade 2 Obesity	35. 0 - 39. 9
Grade 3 Obesity	40. 0 and above

4. **Waist Circumference:** Waist circumference is another useful measurement for assessing central obesity, which is associated with a higher risk of metabolic disorders. It is measured using a flexible tape measure placed around the waist at the level of the natural waistline, usually just above the navel. The measurement should be taken after normal expiration. The cutoff values for waist circumference differ between populations due to variations in body composition and distribution of fat.

High risk of obesity-related health complications indicated by:

Waist circumference ≥ 102 cm (40 inches) in men

Waist circumference ≥ 88 cm (35 inches) in women

5. **Waist-to-Hip Ratio (WHR):** The waist-to-hip ratio (WHR) is another indicator of central obesity and fat distribution. It is calculated by dividing the waist circumference by the hip circumference. A higher WHR indicates a higher proportion of fat stored in the abdominal region. WHR is particularly useful for assessing android or apple-shaped obesity, where fat is primarily distributed around the waist. Android obesity is associated with a higher risk of metabolic disorders compared to gynoid or pear-shaped obesity, where fat is predominantly stored in the hips and thighs.
6. **Skinfold Thickness:** Skinfold thickness measurement is a commonly used method to estimate body composition, particularly body fat percentage. It involves using a skinfold caliper to measure the thickness of skin and subcutaneous fat at specific sites on the body. The most commonly measured sites include the triceps, biceps, subscapular, and suprailiac regions. The measurement is performed by pinching the skin and underlying fat at the selected site, pulling it away from the underlying muscle, and then using the caliper to measure the thickness of the fold in millimeters. These measurements are then plugged into an equation or prediction equation to estimate body fat percentage. While skinfold measurements can provide an estimate of body fat percentage, it's important to note that they have limitations and may not be as accurate as more advanced methods like dual-energy X-ray absorptiometry (DXA) or bioelectrical impedance analysis (BIA).

8.7 REGIONAL DISTRIBUTION OF ADIPOSE TISSUE IN MEN AND WOMEN

Regional distribution of adipose tissue refers to the pattern and location of fat deposits in the body. It varies between men and women due to differences in hormonal profiles, genetic factors, and physiological differences. The fat distribution in the men and women body is different and it is generally two types: Android and gynoid obesity. They are characterized by the accumulation of fat in specific regions, which can have different consequences for health. Let's explore the regional distribution of adipose tissue and their associated consequences.

1. Android Obesity: Android obesity, also known as central obesity or apple-shaped obesity, is characterized by the accumulation of fat predominantly in the abdominal area, particularly around the waistline. In android obesity, there is a higher proportion of visceral adipose tissue (VAT) surrounding the internal organs. This type of fat is metabolically active and releases inflammatory substances and hormones.

Consequences: Android obesity is strongly associated with an increased risk of various health problems, including:

- **Type 2 Diabetes:** The excess visceral fat releases inflammatory molecules that can disrupt insulin sensitivity and glucose metabolism, increasing the risk of developing insulin resistance and diabetes.

- **Cardiovascular Disease:** Visceral fat contributes to elevated levels of triglycerides, LDL cholesterol, and blood pressure, which are all risk factors for heart disease.
- **Metabolic Syndrome:** Android obesity is a major component of metabolic syndrome, which is a cluster of conditions including high blood pressure, high blood sugar, abnormal lipid levels, and insulin resistance.
- **Non-Alcoholic Fatty Liver Disease (NAFLD):** Excess abdominal fat can lead to the accumulation of fat in the liver, causing NAFLD, which can progress to more severe liver conditions.
- **Sleep Apnea:** The presence of excess fat in the abdominal area can contribute to airway obstruction during sleep, leading to sleep apnea.

2. Gynoid Obesity: Gynoid obesity, also known as peripheral obesity or pear-shaped obesity, characterized by the accumulation of fat predominantly in the lower body, particularly around the hips, thighs, and buttocks. In gynoid obesity, there is a higher proportion of subcutaneous adipose tissue (SAT) located just beneath the skin. This type of fat acts as a storage depot for energy.

Consequences: Gynoid obesity is generally considered to have lower metabolic risks compared to android obesity. However, it can still have some implications, such as:

- **Osteoarthritis:** Excess weight in the lower body part increases stress on the joints, particularly the hips and knees, leading to osteoarthritis.
- **Varicose Veins:** The accumulation of fat in the lower body can contribute to the development of varicose veins, which are enlarged and twisted veins.
- **Cellulite:** Gynoid obesity can increase the appearance of cellulite, which is the dimpled, uneven skin texture commonly seen on the buttocks and thighs.

It's important to note that individuals can have a combination of android and gynoid obesity or exhibit variations in fat distribution. Furthermore, the health consequences associated with obesity are not solely determined by fat distribution but are influenced by other factors such as overall body composition, fitness level, and lifestyle factors including diet and physical activity.

In conclusion, android obesity is characterized by the accumulation of fat in the abdominal area, while gynoid obesity is characterized by the accumulation of fat in the lower body. Android obesity is associated with a higher risk of metabolic disorders, cardiovascular disease, and type 2 diabetes due to the metabolic activity of visceral fat. Gynoid obesity, although generally considered to have lower metabolic risks, can still contribute to joint problems and cosmetic concerns. It's important to address obesity through lifestyle modifications, including a balanced diet, regular physical activity, and overall weight management, regardless of the fat distribution pattern.

The regional distribution of adipose tissue is influenced by several factors, including hormonal profiles. Estrogen, the primary female sex hormone, plays a role in directing fat storage to the hips and thighs, resulting in the gynoid pattern of fat distribution. In men, higher levels of testosterone promote fat storage in the abdominal area, leading to the android pattern. Hormonal changes that occur during puberty and menopause can also influence the distribution of body fat.

Genetic factors also contribute to the regional distribution of adipose tissue. Specific genes are involved in regulating fat deposition in different areas of the body. Genetic variations can influence the activity of these genes, leading to differences in fat distribution between individuals.

Furthermore, physiological differences between men and women contribute to variations in fat

distribution. Men generally have a higher percentage of muscle mass compared to women, which can affect overall body composition and fat distribution. Muscle tissue is metabolically active and can influence the storage and utilization of fat.

The differences in regional distribution of adipose tissue between men and women have implications for health outcomes. Central obesity, characterized by excess visceral fat in men, is strongly associated with an increased risk of chronic diseases, including type 2 diabetes, cardiovascular disease, and metabolic syndrome. This is because visceral fat is metabolically active and releases inflammatory substances and hormones that can disrupt insulin sensitivity and lipid metabolism. In contrast, peripheral obesity in women, characterized by excess subcutaneous fat in the lower body, is generally considered to have a lower metabolic risk.

However, it is important to note that these patterns are not absolute, and individuals may vary in their fat distribution. Some women may have more central fat deposition, while some men may have a more peripheral fat distribution. Additionally, the health implications of fat distribution can be influenced by other factors such as overall body composition, fitness level, and lifestyle factors including diet and physical activity.

In conclusion, the regional distribution of adipose tissue differs between men and women. Men tend to accumulate more fat in the abdominal region, while women tend to have a greater accumulation of fat in the hips, thighs, and buttocks. These differences are influenced by hormonal profiles, genetic factors, and physiological differences. Central obesity in men is associated with an increased risk of chronic diseases, while peripheral obesity in women is generally considered to have a lower metabolic risk. Understanding the regional distribution of adipose tissue is important in assessing health risks and developing targeted strategies for disease prevention and management.

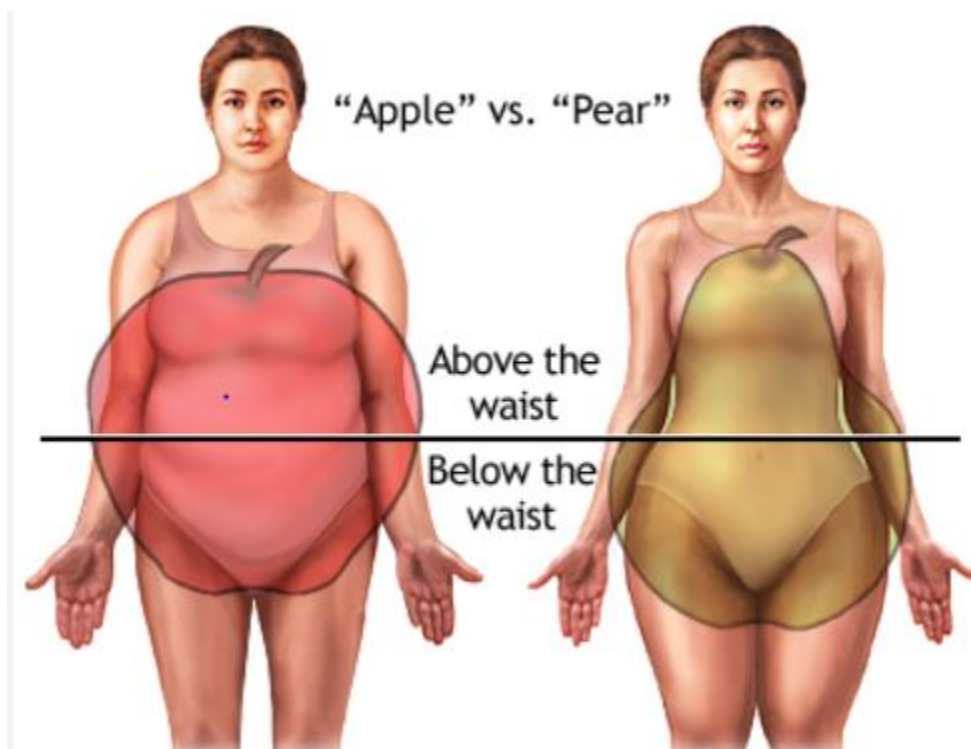


Figure 8. 1: Regional distribution of adipose tissue in men and Women

Source: Medline plus Medical Encyclopedia

8.8 TYPES OF OBESITY

There are several types or classifications of obesity based on different criteria. Here are some commonly recognized types of obesity:

1. **Android or Central Obesity:** This type of obesity is characterized by the accumulation of excess fat primarily in the abdominal area, resulting in an "apple-shaped" body. It is more common in women and associated with an increased risk of cardiovascular disease, diabetes, and metabolic syndrome.
2. **Gynoid or Peripheral Obesity:** Gynoid obesity refers to the accumulation of excess fat predominantly in the hip and thigh region, resulting in a "pear-shaped" body. It is more common in women and is generally considered less detrimental to health compared to central obesity.
3. **Adult-onset Obesity:** Adult-onset obesity, also known as late-onset or acquired obesity, refers to the development of obesity in adulthood. It is an overall excess body fat distribution without a specific pattern of accumulation. It involves an increase in fat deposits throughout the body, including subcutaneous and visceral adipose tissue. Unlike childhood obesity, which occurs during early life stages, adult-onset obesity typically occurs after the age of 18. It is important to note that adult-onset obesity can also be a continuation of childhood obesity that persists into adulthood.

Several factors contribute to the development of adult-onset obesity such as (a) Engaging in minimal physical activity and leading a sedentary lifestyle can result in energy imbalance, where calorie intake exceeds calorie expenditure. (b) Environmental factors, such as access to unhealthy food options, built environments that discourage physical activity, and cultural or societal norms that promote sedentary behavior, can influence the development of adult onset obesity. (c) Genetic factors play a role in the development of obesity, including adult-onset obesity. Certain genetic variations can affect metabolism, fat storage, and appetite regulation, making individuals more susceptible to weight gain. (d) Hormonal changes that occur with aging, such as a decrease in metabolic rate and changes in hormone levels, can contribute to weight gain and the development of obesity in adulthood. (e) Adult-onset obesity is associated with an increased risk of developing various chronic diseases such as type 2 diabetes, cardiovascular disease, hypertension, certain cancers, and metabolic syndrome which leads obesity.

4. **Childhood Obesity:** Childhood obesity refers to excess body fat in children and adolescents. It is a significant public health concern due to its association with various health problems, including type 2 diabetes, cardiovascular disease, and psychosocial issues.

It's a global health issue, with increasing prevalence rates in recent years. Childhood obesity is typically determined by measuring a child's body mass index (BMI) and comparing it to age- and sex-specific growth charts.

Consequences of childhood obesity:

- *Physical Health Problems:* Obese children are at a higher risk of developing several health issues, including type 2 diabetes, high blood pressure, heart disease, respiratory problems, and musculoskeletal disorders.
- *Psychological and Emotional Issues:* Childhood obesity can lead to low self-esteem, body image dissatisfaction, depression, and social isolation, which can have long-lasting effects on mental well-being.
- *Academic Performance:* Obese children may face difficulties in school due to reduced

concentration, decreased cognitive function, and poor academic performance.

- *Long-term Health Risks:* Childhood obesity increases the risk of obesity persisting into adulthood, leading to a higher likelihood of developing chronic diseases such as diabetes, cardiovascular disease, and certain types of cancer.
- 5. **Morbid Obesity:** Morbid obesity is a severe form of obesity characterized by a body mass index (BMI) of 40 or higher, which is characterized by excessive and unhealthy accumulation of body fat. Morbid obesity significantly increases the risk of developing serious health conditions such as type 2 diabetes, high blood pressure, heart disease, stroke, certain cancers, sleep apnea, osteoarthritis, and reproductive disorders. The causes of morbid obesity are complex and multifactorial. Genetic factors, hormonal imbalances, unhealthy eating habits, sedentary lifestyle, psychological factors, and environmental influences play a vital role in its development. Managing morbid obesity requires a comprehensive approach. Lifestyle modifications including dietary changes, increased physical activity, behavior therapy, and support groups may be recommended as the first-line of treatment. In some cases, medical interventions such as weight loss, medications or bariatric surgery may be considered.
- 6. **Metabolically Healthy Obesity:** Some individuals with obesity may exhibit normal metabolic profiles, such as normal blood pressure, cholesterol, and glucose levels, despite having excess body fat. However, it is important to note that long-term health risks may still exist, and close monitoring is necessary.

These classifications of obesity provide insights into the distribution and health implications of excess body fat. It is essential to consider individual factors, such as body composition, metabolic health, and underlying medical conditions, when assessing and managing obesity.

8.9 PROBLEMS RELATED TO OBESITY

Obesity is a complex health issue that can lead to a range of problems and complications. Here are some common problems related to obesity:

1. **Increased Risk of Chronic Diseases:** Obesity is strongly associated with an increased risk of chronic diseases such as type 2 diabetes, heart disease, stroke, hypertension (high blood pressure), certain types of cancer (such as breast, colon, and kidney cancer), and respiratory disorders.
2. **Cardiovascular Problems:** Excess body weight puts a strain on the cardiovascular system, leading to an increased risk of heart disease, heart attacks, and strokes. Obesity can contribute to the development of atherosclerosis (hardening of the arteries) and high levels of cholesterol and triglycerides in the blood.
3. **Metabolic Syndrome:** Obesity is often accompanied by metabolic syndrome, a cluster of conditions that include high blood pressure, high blood sugar levels, abnormal cholesterol levels, and excess abdominal fat. Metabolic syndrome increases the risk of heart disease, stroke, and type 2 diabetes.
4. **Type 2 Diabetes:** Obesity is a significant risk factor for the development of type 2 diabetes. Excess body fat can lead to insulin resistance, where the body's cells become less responsive to insulin, resulting in elevated blood sugar levels.
5. **Joint Problems:** The excess weight carried by obese individuals puts stress on the joints, particularly in the knees, hips, and ankles. This can lead to joint pain, osteoarthritis, and decreased mobility.

6. **Respiratory Issues:** Obesity can contribute to respiratory problems, including sleep apnea, a condition characterized by interrupted breathing during sleep. Obesity-related hypoventilation syndrome (OHS) is another respiratory issue that occurs when excess weight restricts chest expansion and impairs lung function.
7. **Mental Health Concerns:** Obesity can have negative effects on mental health and contribute to conditions such as depression, anxiety, and low self-esteem. Social stigmatization and discrimination related to body weight can also impact psychological well-being.
8. **Increased Surgical Risks:** Obese individuals may face increased risks during surgical procedures due to difficulties with anesthesia administration, longer operative times, and higher rates of complications such as infections, wound healing issues, and blood clots.
9. **Reproductive Problems:** Obesity can affect reproductive health in both men and women. In women, it can lead to menstrual irregularities, infertility, polycystic ovary syndrome (PCOS), and complications during pregnancy. In men, obesity has been linked to lower testosterone levels and reduced fertility.
10. **Reduced Quality of Life:** Obesity can significantly impact an individual's quality of life, leading to decreased physical mobility, limitations in daily activities, and a higher risk of disability. It can also affect social interactions, self-image, and overall well-being.

It's important to note that obesity is a complex condition influenced by various factors, including genetics, environment, lifestyle choices, and socioeconomic factors.

8. 10 CONCEPT ENERGY BALANCE FOR WEIGHT LOSS

The concept of energy balance plays a crucial role in weight loss. Energy balance refers to the relationship between the calories you consume through food and the calories you expend through physical activity and bodily functions. To achieve weight loss, you need to create a negative energy balance, meaning your energy expenditure exceeds your energy intake. Calorie deficit and energy balance are key concepts when it comes to managing obesity. Let's understand how energy balance relates to weight loss:

1. **Calorie Deficit:** A calorie deficit occurs when you consume fewer calories than your body needs for daily activities and maintenance. This deficit forces your body to tap into stored energy (fat) to make up for the shortfall, leading to weight loss.

The formula for calculating calorie deficit is:

$$\text{Calorie Deficit} = \text{Calorie}_{\text{intake}} - \text{Calorie}_{\text{output}}$$

In the above equation, $\text{Calorie}_{\text{intake}}$ refers to the number of calories that we consume every day, either through food or drink.

The term $\text{Calorie}_{\text{output}}$ is the number of calories that our body needs to maintain our current weight and activity levels.

If $\text{Calorie}_{\text{output}} > \text{Calorie}_{\text{intake}}$

you are in a calorie deficit, and you would lose weight.

If it is the other way around, i. e. , $\text{Calorie}_{\text{output}} < \text{Calorie}_{\text{intake}}$

you are in a calorie surplus, and you will gain weight.

A detailed 24-hour food recall and /or 3-day diet history are generally advised to determine calorie intake.

Creating a calorie deficit is essential for losing excess body weight and reducing obesity. There are only two ways to maintain a calorie deficit:

- Eating fewer calories than what you burn; and
- Burning more calories than what you eat.

It is always recommended to combine both of the above for healthy weight loss. Now, one must be questioning how much calorie is needed to create a calorie deficit diet and healthy weight loss.

It is important to remember that 1 pound (0.45 kg) of fat is about 3,500 calories. Hence, to lose 1 pound of fat, there is a need to create a calorie deficit of 3,500 calories. This means to lose 1 pound per week, one should consume $3500 / 7 = 500$ calories less than the number of calories your body needs per day.

To lose weight without significantly affecting your energy levels, you should aim for a calorie deficit of 500 calories per day.

Subtracting this deficit from estimated calorie needs will give the target calorie intake for weight loss.

The general guideline is to aim for a deficit of 500-1000 calories per day to achieve a gradual and sustainable weight loss of 1-2 pounds per week. Once the target is fixed, progress should be checked once a month. Usually, 3kg is lost in the first month largely due to utilization of carbohydrate store and water. Reducing diet should provide adequate amount of protein, vitamins and minerals. In the next section, the energy deficit for weight loss will be effectively calculated.

Steps for Energy Deficit Calculation

Step 1: Calculating the Resting Energy Estimation (REE)

REE for Men: $= 10 \times \text{weight (kg)} + 6.25 \times \text{height (cm)} - 5 \times \text{age (years)} + 5.$

REE for Women: $= 10 \times \text{weight (kg)} + 6.25 \times \text{height (cm)} - 5 \times \text{age (years)} - 161.$

STEP 2: Estimate daily calorie need.

REE X Activity factor (AF) = Daily calorie need (Kcal/day) to maintain weight

For light activity, the activity factor is 1.5 for women and for men the activity factor is 1.6.

STEP 3: Adjust calorie intake

From this number, subtract 500 Kcal/day to obtain adjusted calorie intake required to achieve weight loss of approximately 500g/week.

Example: A person weighs 78 kg with an energy match at 2750 Kcal. To reach the desired weight, how many calories should be reduced for a person?

Expected loss of weight- 500g/week

1g of body fat is equivalent- 7.7 Kcal

500 g of body fat is equivalent to $7.7 \times 500 = 3850$ Kcal

Less calories per day $= 3850 / 7 = 550$ Kcal

Prescribed calories per day $= 2750 - 550 = 2200$ Kcal

So, to achieve a loss of 500g/week, 2200 Kcal are advised.

It's recommended to make gradual changes rather than extreme calorie restriction to prevent nutrient deficiencies and maintain a healthy metabolism.

Table 8. 5: Loss of weight on low calorie diet (Source: Sri Laxmi, 2010)

BMI	Less calories/day	Weight loss/week	Weight loss in six months
27-35	300-500	0. 5 kg	10% weight loss
>35	500-1000	0. 5-1 kg	10% weight loss

8. 11 TREATMENT

Managing obesity requires a multidimensional approach, including lifestyle modifications, dietary changes, physical activity, behavioral therapy, and, in some cases, medical interventions.

The main criteria for weight loss are to be considered: (1) slow and gradual reduction of body weight till it is closer to ideal body weight (2) maintenance of weight loss achieved; and (3) prevention of complications like heart disease or diabetes mellitus.

Here are some key components of a comprehensive approach to managing obesity as below:

Strategies for weight loss

1. Diet Therapy
2. Behavior Modification
3. Physical exercise
4. Stress Management
5. Weight loss surgery

8. 11. 1 Diet Therapy

When it comes to managing obesity, it's important to focus on creating a balanced and nutritious diet that supports weight loss and overall health. Generally, low calorie diet with normal protein, vitamins and minerals are recommended. Although, refined carbohydrates and fats are restricted. Liberal intake of fibers and fluids are advisable. Let us study in detail that what modifications are needed in the amount of energy, protein, carbohydrate, fat, vitamins and minerals for obese individuals.

Here are some key nutritional considerations for individuals with obesity:

1. Reducing Caloric Intake: Obesity is a result of energy imbalance in the body. So, modifications in energy (calorie) needs are important. To promote weight loss, it is required to create a calorie deficit by either reducing caloric intake, increasing physical activity, or a combination of both. A calorie deficit of 500-1000 calories per day will help in losing weight of 1-2 pounds per week. In the previous section it was discussed how to calculate the calorie deficient diet and how much calorie is needed to achieve the desirable weight loss. Rapid weight loss diets often involve severe calorie restriction, which may result in inadequate nutrient intake. Gradual weight loss allows for a more sustainable and healthier approach of losing weight. As rapid weight loss can be challenging to maintain in the long term and often leads to regaining the weight back. Gradual weight loss allows the body to adapt changes and helps to establish healthier habits that can be maintained over time. When losing weight too quickly, there is a higher chance of losing muscle mass along with fat. Preserving muscle mass is important as it contributes to a higher metabolic rate, which can help with weight management in the long run.

2. Protein: Protein is essential for maintaining muscle mass and promoting satiety. About 0.8-1g of protein/kg body weight is sufficient to meet the need. Although extra allowance is advisable as it improves the satiety value of the diet. Most of the diet plans can include 70-100gm of protein per day. Lean sources of protein like skinless poultry, fish, lean cuts of meat, legumes, and low-fat dairy products are advisable.

3. Fat: Experiments have shown that when fat content of the diet increases, those without body weight problems are able to regulate their body weight by unknowingly reducing the amount of food eaten and hence, controlling the number of calories eaten. But low fat or no fat diet should be given to reduce the energy value of food. Saturated fats, visible fats and cholesterol-rich foods should be avoided.

4. Vitamins and Minerals: When it comes to weight loss diets, it's important to focus on a balanced and nutrient-rich approach rather than relying solely on specific vitamins and minerals. However, certain nutrients play a significant role in supporting weight loss and overall health such as calcium, magnesium, vitamin D and vitamin B6, vitamin 12 and folate. A well-balanced diet should include a proper distribution of macronutrients – carbohydrates, proteins, and fats. However, the specific distribution may vary depending on individual needs and preferences. It is generally recommended to focus on high-quality sources of protein, complex carbohydrates, and healthy fats. It's important to note that individual nutritional requirements may vary based on factors such as age, sex, weight, activity level, and any underlying health conditions.

To promote weight loss, it's important to create a calorie deficit by consuming fewer calories than your body needs. Here are some strategies to help reduce calorie consumption:

- *High-Fiber Foods:* Including fiber-rich foods in your diet can help promote satiety, regulate blood sugar levels, and support digestive health. Opt for whole grains, fruits, vegetables, legumes, and nuts, which are all excellent sources of dietary fiber.
- *Lean Protein Sources:* Protein plays a crucial role in weight management as it helps to maintain muscle mass, promotes satiety, and aids in the recovery and repair of body tissues. Include lean protein sources such as skinless poultry, fish, lean meats, low-fat dairy products, legumes, and tofu.
- *Healthy Fats:* While it's important to moderate fat intake to control overall calorie consumption, it's also essential to include sources of healthy fats in your diet. These include avocados, nuts, seeds, olive oil, and fatty fish like salmon. These fats provide essential fatty acids and help keep you feeling satisfied.
- *Increase Fruit and Vegetable Intake:* Fruits and vegetables are low in calories and high in nutrients, fiber, and water content. Increase your intake of these foods to add volume and satiety to meals without adding excessive calories.
- *Identify High-Calorie Foods:* Identify foods that are high in calories but low in nutritional value, such as sugary snacks, fried foods, processed snacks, and sugary beverages. These are often sources of empty calories and can be reduced or eliminated from your diet.
- *Healthy Snacking:* If needed, plan for healthy snacks between meals to keep hunger at bay. Choose nutrient-dense options such as a handful of nuts, Greek yogurt, raw vegetables with hummus, or a piece of fruit.
- *Limit Processed Foods:* Processed foods tend to be higher in calories, sodium, and unhealthy fats. Focus on whole, unprocessed foods as much as possible to reduce calorie intake and improve overall nutrition.

- *Portion Control:* Pay attention to portion sizes to prevent overeating. Use smaller plates, measure and weigh food portions, and be mindful of calorie-dense foods that can easily contribute to excessive calorie intake.
- *Limit Added Sugars:* Foods and beverages high in added sugars can contribute to weight gain and have limited nutritional value. Minimize the intake of sugary drinks, sweets, pastries, and processed snacks. Opt for natural sources of sweetness like fruits.
- *Hydration:* Stay hydrated by drinking plenty of water throughout the day. Water can help with appetite control and may replace high-calorie beverages. Limit the intake of sugary drinks, sodas, and other calorie-laden beverages.
- *Regular Physical Activity:* In addition to dietary changes, regular physical activity is essential for managing obesity. Engage in a combination of aerobic exercises, strength training, and other forms of physical activity to support weight loss and improve overall fitness.

Remember, creating sustainable habits and making long-term lifestyle changes are key to successful weight management. It's important to find a feeding pattern that works for you, supports your goals, and is enjoyable and maintainable in the long run.

8. 11. 2 Behavior Modification

Behavior modification is a key component of successful weight loss and long-term weight management. It involves making intentional changes to your behaviors, habits, and mindset to support healthy eating, physical activity, and overall lifestyle changes. Initially, it is important to track your daily food intake to increase awareness of eating patterns, portion sizes, and calorie consumption. This can help identify areas for improvement and provide insights into your eating habits. Pay attention to your body's hunger and fullness cues. Eat slowly, savor each bite, and avoid distractions like TV or phones during meals. This allows better recognition, satisfaction and helps prevent overeating.

Then, pay focus and identify the environmental factors that influence food intake and gradually modify these so that a change in eating habits and subsequent weight loss occur. In addition, planning meals in advance and preparing healthy, balanced options. This reduces the likelihood of making impulsive, unhealthy food choices. Stock your kitchen with nutritious foods and limit the presence of tempting, calorie-dense snacks. Use smaller plates and bowls to control portion sizes and prevent overeating. Be mindful of serving sizes recommended for different food groups and aim for balanced meals with appropriate portions of protein, carbohydrates, and vegetables. Be mindful of emotional eating triggers and develop strategies to cope with emotions without turning to food. Find alternative ways to manage stress, boredom, or other emotional triggers, such as engaging in physical activity, practicing relaxation techniques, or seeking support from others. Incorporating regular physical activity in daily routine. Finding activities, one used to enjoy and make them a regular part of daily life. Start with small, achievable goals and gradually increasing the duration and intensity of workouts.

8. 11. 3 Physical exercise

Regular physical exercise increases energy expenditure, helping to create a calorie deficit. This deficit, when combined with a balanced diet, promotes weight loss by burning excess body fat. Exercise enhances insulin sensitivity, allowing cells to better utilize glucose for energy. This can help prevent insulin resistance and reduce the risk of developing type 2 diabetes, a condition often associated with obesity. In addition, regular exercise can help to regulate appetite hormones, such as ghrelin and leptin. It can decrease ghrelin (the hunger hormone) levels and increase leptin (the satiety hormone) levels, leading to better appetite control and reduced overeating. Physical activity,

particularly aerobic exercises like jogging or cycling, can effectively reduce visceral fat, which is the harmful fat that accumulates around the abdominal organs. Decreasing abdominal fat is associated with a decreased risk of obesity-related health complications. Regular physical activity can reduce stress, anxiety, and depression, which are often associated with emotional eating and weight gain.

Transitioning from a sedentary lifestyle to a more active one can be challenging, but it is certainly achievable. Start by setting realistic and achievable goals. Begin with small steps and gradually increase activity level over time. For example, aim to take a 10-minute walk after dinner or incorporate short activity breaks during workday. Engage in activities that one used to genuinely enjoy. This could be walking, swimming, dancing, cycling, hiking, or playing a sport. When you find an activity that you enjoy, it's more likely that you'll stick with it in the long term. In addition, look for opportunities to incorporate more movement into daily activities. Take the stairs instead of the elevator, park car farther away from destination to get in some extra walking, or try standing up and stretching during TV commercial breaks. Furthermore, create a routine and make physical activity a regular part of daily life.

8. 11. 4 Stress Management

Lack of exercise, combined with stress-related eating, can contribute to weight gain and hinder weight loss efforts. Stress can trigger emotional eating and lead to overconsumption of high-calorie, unhealthy foods. This is because stress activates the release of cortisol, a hormone that can increase appetite and cravings for comfort foods. Stress also disrupts sleep patterns, which can contribute to weight gain. Poor sleep quality or insufficient sleep can affect hormones that regulate hunger and satiety, leading to an increased desire for food and decreased feelings of fullness.

Moreover, stress can impact metabolism and fat storage. Chronic stress can lead to insulin resistance, which affects how the body processes and stores glucose, potentially promoting weight gain and the development of obesity. Managing stress through techniques such as exercise, meditation, deep breathing, and engaging in activities that promote relaxation can help reduce stress-related eating and support healthier behaviors. By effectively managing stress, individuals can improve their chances of successful weight management and overall well-being.

8. 11. 5 Weight loss surgery

Surgical treatment for obesity, also known as bariatric surgery, is an option for individuals with severe obesity or those who have not been successful with other weight loss methods. It involves various procedures that aim to reduce the size of the stomach, limit food intake, and sometimes alter the digestive process. Here are some common types of bariatric surgery:

1. *Gastric bypass surgery*: This procedure involves creating a small pouch at the top of the stomach and connecting it directly to the small intestine, bypassing a large portion of the stomach and upper small intestine. This reduces the amount of food one can eat and decreases the absorption of calories and nutrients.
2. *Sleeve gastrectomy*: This procedure involves removing a large portion of the stomach, leaving a smaller, banana-shaped sleeve. The reduced stomach size restricts food intake and leads to earlier satiety.
3. *Adjustable gastric banding*: In this procedure, an inflatable band is placed around the upper part of the stomach, creating a small pouch above the band. The band can be adjusted to control the size of the stomach opening, restricting the amount of food that can be consumed.
4. *Biliopancreatic diversion with duodenal switch*: This complex procedure involves removing a large portion of the stomach, similar to sleeve gastrectomy, and rerouting the intestines to limit the absorption of calories and nutrients.

Bariatric surgery is usually considered when other weight loss methods have been unsuccessful and when individuals have a body mass index (BMI) of 40 or higher (or BMI of 35 or higher with obesity-related health conditions). It is important to note that bariatric surgery is a major medical procedure and should only be considered after a thorough evaluation and discussion with healthcare professionals. Potential risks and complications, as well as long-term lifestyle changes and follow-up care, should be carefully considered before opting for surgical treatment for obesity.

But before moving to the other section, let's recapitulate what we have learnt so far.

Check Your Progress Exercise 1

1. Enlist the different assessment method of obesity.

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2. Name the hormones that play an important role in obesity.

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3. Write the difference between android and gynoid obesity.

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8. 12 DIET FOR UNDERWEIGHT

Underweight refers to having a body weight that is lower than what is considered healthy for an individual's age, height, and gender. It can be a result of various factors, including genetics, metabolism, inadequate caloric intake, underlying medical conditions, or certain eating disorders. Gaining weight in a healthy manner requires a balanced approach that focuses on increasing calorie intake, choosing nutrient-dense foods, and incorporating regular exercise. It is important to prioritize overall health and well-being while working towards achieving a healthy weight. For individuals who are underweight, it is important to focus on a balanced and nutritious diet that promotes healthy weight gain. In this article, we will discuss etiology, consequence, dietary recommendations and strategies for individuals looking to gain weight in a healthy manner.

8. 13 ETIOLOGY OF UNDERWEIGHT

The etiology of underweight, or being below a healthy body weight, can be attributed to various factors. Here are some common causes of underweight:

1. *Inadequate caloric intake*: Not consuming enough calories to meet the body's energy needs can result in weight loss and underweight. This can be due to poor appetite, limited food availability, restrictive eating patterns, or disordered eating behaviors.

2. *Nutrient deficiencies:* Inadequate intake of essential nutrients like proteins, carbohydrates, fats, vitamins, and minerals can lead to underweight. Nutrient deficiencies can occur due to a lack of variety in the diet, poor food choices, or certain medical conditions that impair nutrient absorption.
3. *High metabolic rate:* Some individuals naturally have a higher metabolic rate, which means their bodies burn calories at a faster rate. This can make it challenging to maintain or gain weight, even with sufficient caloric intake.
4. *Chronic diseases or medical conditions:* Certain chronic diseases or medical conditions can contribute to unintentional weight loss and underweight. Examples include gastrointestinal disorders, malabsorption syndromes, thyroid disorders, cancer, HIV/AIDS, and eating disorders.
5. *Increased energy expenditure:* Engaging in intense physical activity, participating in endurance sports, or having a physically demanding job can increase energy expenditure, leading to weight loss and underweight if caloric intake does not match the energy requirements.
6. *Genetics:* Genetic factors can influence an individual's body composition and weight regulation. Some individuals may have a naturally lower body weight due to genetic predispositions.
7. *Psychological factors:* Underweight can be associated with psychological factors such as stress, anxiety, depression, and body image concerns. These factors can affect appetite, eating behaviors, and overall nutritional status.
8. *Socioeconomic factors:* Limited access to nutritious food, poverty, and food insecurity can contribute to underweight, especially in low-income communities or countries with inadequate food resources.

It's important to note that individual cases of underweight may have a combination of these factors, and a thorough medical evaluation is often necessary to determine the underlying cause.

8.14 SIGNS AND SYMPTOMS OF UNDERWEIGHT

1. *Low Body Weight:* One of the primary signs of underweight is having a body weight that is significantly below the expected range for an individual's height and age. It can be assessed using body mass index (BMI) calculations or other weight-for-height measurements.
2. *Visible Prominence of Bones:* Individuals who are underweight may have prominent bones, especially in areas such as the ribs, collarbones, and shoulder blades. This is often a result of reduced body fat and muscle mass.
3. *Thin or Fragile Appearance:* Underweight individuals may appear thin, frail, or emaciated. Their overall body shape and structure may lack the typical muscle tone and mass associated with a healthy weight.
4. *Lack of Energy and Fatigue:* Underweight individuals may experience constant fatigue and lack of energy. This can be due to insufficient caloric intake, nutrient deficiencies, or an inadequate supply of energy for bodily functions.
5. *Weak Immune System:* Underweight individuals may have a weakened immune system, making them more susceptible to infections, frequent illnesses, and slower recovery from illnesses or injuries.

6. *Delayed Puberty:* In adolescents, underweight can lead to delayed onset of puberty or irregular menstrual cycles in females. This is because the body requires a certain level of body fat for normal hormonal functioning.
7. *Poor Wound Healing:* Underweight individuals may experience slow wound healing due to reduced nutrient availability and compromised immune function.
8. *Hair Loss and Brittle Nails:* Inadequate nutrition and nutrient deficiencies associated with underweight can lead to hair loss, thinning hair, and brittle nails.
9. *Cold Intolerance:* Underweight individuals may have difficulty maintaining body temperature and may feel cold more easily. This is because body fat plays a role in insulation and heat regulation.

8.15 ASSESSMENT OF UNDERWEIGHT

Assessing underweight typically involves evaluating an individual's body weight in relation to their height and determining if it falls below a healthy range. One commonly used assessment tool is the Body Mass Index (BMI), which calculates an individual's weight in kilograms divided by the square of their height in meters; which have already discussed in previous section of this unit.

According to WHO,

BMI < 18.5 generally considered as underweight.

However, it's important to note that BMI is not always a comprehensive indicator of health, as it does not account for muscle mass or body composition. BMI can provide a general indication of underweight, it is important to consider other factors as well, such as overall health, body composition, and individual circumstances. Assessing body composition can provide a more accurate picture of underweight. For example, individuals with low muscle mass may have a lower weight, but not necessarily due to inadequate nutrition or overall health issues. Since, inadequate calorie intake, poor nutrition, or restricted eating patterns can contribute to being underweight. Evaluating the individual's dietary habits and nutrient intake will also help to identify the underweight.

8.16 CONSEQUENCES OF UNDERWEIGHT

Underweight can have significant implications for health and well-being. It is important to recognize the signs and symptoms of underweight and understand the potential consequences.

1. *Nutrient Deficiencies:* Underweight individuals are at a higher risk of nutrient deficiencies, including protein, vitamins, and minerals. This can lead to various health problems, impaired immune function, and delayed healing.
2. *Weakened Immune System:* Underweight individuals often have a compromised immune system, making them more susceptible to infections, illnesses, and poor recovery from diseases.
3. *Reduced Muscle Mass and Strength:* Inadequate calorie and protein intake can result in muscle wasting and loss of muscle mass, leading to reduced strength, decreased physical performance, and increased risk of injuries.
4. *Increased Risk of Osteoporosis:* Insufficient weight-bearing exercise and inadequate nutrient intake can increase the risk of osteoporosis, a condition characterized by weak and brittle bones.

5. *Hormonal Imbalances:* Underweight individuals may experience hormonal imbalances, particularly in women. This can lead to menstrual irregularities, fertility issues, and hormonal disturbances affecting overall well-being.
6. *Impaired Cognitive Function:* Inadequate nutrition and energy supply to the brain can impair cognitive function, affecting memory, concentration, and overall mental well-being.
7. *Reduced Fertility:* Underweight women may experience difficulties in conceiving due to hormonal imbalances and irregular menstrual cycles.
8. *Increased Risk of Complications during Pregnancy:* Underweight women who become pregnant may face an increased risk of complications, such as preterm birth, low birth weight of the baby, and nutrient deficiencies that can affect fetal development.
9. *Impaired Growth and Development:* In children and adolescents, underweight can hinder proper growth and development, affecting height, bone density, and overall physical and cognitive development.
10. *Decreased Overall Mortality:* Numerous studies have shown that underweight individuals have an increased risk of mortality compared to individuals with a healthy weight. This increased mortality risk is often associated with underlying health conditions, weakened immune system, and complications of chronic diseases.

8.17 DIET IN UNDER WEIGHT

1. **Increase Caloric Intake:** The primary goal for underweight individuals is to consume more calories than their basic energy requirement. A 500 Kcals per day is recommended and this can be achieved by increasing portion sizes and incorporating energy-dense foods into the diet. Some high-calorie food options include nuts and nut butter, avocados, full-fat dairy products, lean meats, dried fruits, and healthy oils like olive oil and coconut oil.
2. **Protein-Rich Foods:** Protein is essential for muscle growth and repair, which is important for healthy weight gain. 1. 2 gm of protein per day is recommended as extra allowance is required for tissues building. Liberal intake of good quality of protein, such as lean meats, poultry, fish, eggs, dairy products, legumes, nuts, and seeds is advisable in each meal.
3. **Healthy Fats:** Include healthy fats in your diet as they are calorie-dense and provide important nutrients. High calorie fatty foods such as cream, butter, and oil help to increase the weight, however fried fatty food are not recommended. It is important to consume easily digestible fat in moderation and balance them with other nutrients. Good sources of healthy fats include avocados, nuts, seeds, olive oil, and fatty fish like salmon is advisable.
4. **Carbohydrates:** Carbohydrates are an important source of energy and can help meet calorie needs. High carbohydrate food is recommended to increase the weight. Include starchy vegetables in your diet such as potatoes, sweet potatoes, corn, and peas. These vegetables are higher in carbohydrates and can contribute to your overall calorie intake. Incorporate a variety of fruits in your diet as they provide natural sugars, fiber, and essential nutrients. Opt for whole fruits rather than fruit juices to benefit from the fiber content. Intake of calorie dense food such as dried fruits, porridge, desserts, nuts, chips, can be liberally included in diet.

8.18 FEEDING PATTERN FOR UNDERWEIGHT

When it comes to addressing underweight concerns, establishing a healthy feeding pattern is essential to promote weight gain and overall well-being. Here are some feeding pattern strategies

that can be beneficial:

1. **Regular and Frequent Meals:** Aim to have regular meals throughout the day, including breakfast, lunch, dinner, and snacks in between. Try to eat every 2-3 hours to provide a continuous source of energy and nutrients for weight gain.
2. **Calorie-Dense Foods:** Choose nutrient-dense foods that are higher in calories to increase overall calorie intake. Include foods such as nuts, seeds, nut butter, avocados, full-fat dairy products, lean meats, and healthy oils in your meals and snacks.
3. **Balanced Meals:** Focus on creating balanced meals that include a combination of carbohydrates, proteins, and fats. Include complex carbohydrates like whole grains, starchy vegetables, and legumes, along with lean sources of protein such as chicken, fish, tofu, and beans. Add healthy fats from sources like olive oil, nuts, and seeds.
4. **Protein-Rich Foods:** Adequate protein intake is important for muscle growth and repair. Include protein-rich foods in each meal, such as lean meats, poultry, fish, eggs, dairy products, legumes, and plant-based protein sources like tofu and tempeh.
5. **Nutrient-Dense Snacks:** Incorporate nutrient-dense snacks in between meals to increase calorie and nutrient intake. Snack on foods like yogurt, cheese, nuts, dried fruits, granola bars, smoothies, or protein shakes.
6. **Fluid Intake:** Stay hydrated by consuming an adequate amount of fluids throughout the day. Opt for calorie-containing beverages such as milk, smoothies, or fruit juices to add extra calories in diet.
7. **Eat Mindfully:** Pay attention to hunger and fullness cues while eating. Focus on enjoying meals and snacks, and avoid distractions like screens or multitasking. Eating slowly and chewing thoroughly can also help with digestion and nutrient absorption.
8. **Consider Nutritional Supplements:** If necessary, talk to a healthcare professional about the potential need for nutritional supplements to ensure you're meeting your nutrient requirements. They can recommend appropriate supplements like protein powders, meal replacement shakes, or vitamins and minerals.
9. **Regular Physical Activity:** Engaging in regular physical activity, such as strength training exercises, can help stimulate appetite, promote muscle growth, and support healthy weight gain. Consult with a healthcare professional or fitness expert for guidance on appropriate exercises.

But before moving to the other section, let us recapitulate what we have learnt so far.

Check Your Progress Exercise 2

1. What are the common methods to identify underweight.

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2. Discuss the common symptoms in underweight.

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3. Explain the dietary modification in underweight

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8.19 LET US SUM UP

Weight management is a lifelong process and should be approached with a balanced and holistic perspective. It involves a combination of healthy eating, regular physical activity, stress management, and adequate sleep. Maintaining a healthy weight reduces the risk of developing various chronic conditions, including heart disease, type 2 diabetes, certain types of cancer, high blood pressure, and joint problems. Weight management can also improve overall energy levels, sleep quality, and mental well-being. It's important to approach weight loss with a long-term perspective and focus on sustainable lifestyle changes rather than quick fixes or fad diets. Gradual weight loss is generally recommended, as it allows for a healthier and more maintainable approach. Successful weight loss requires creating a calorie deficit, which means consuming fewer calories than the body needs for daily energy expenditure. This can be achieved through a balanced and nutritious diet that emphasizes whole foods, portion control, and reduction in calorie-dense and unhealthy choices. Regular physical activity is also crucial, as it not only burns calories but also improves overall fitness, metabolism, and muscle tone. Weight management plays a significant role in improving overall quality of life. It enables individuals to engage in physical activities they enjoy, have a more positive body image, experience improved mobility, and maintain better overall health. Additionally, seeking guidance from healthcare professionals, such as registered dietitians or doctors, can provide personalized advice and support throughout the weight loss journey.

8.20 CHECK YOUR PROGRESS

Check Your Progress Exercise 1

1. The different assessment method of obesity are: body fat percentage, body weight, body mass index (BMI), waist circumference, waist-to-Hip Ratio (WHR), and skinfold thickness.
2. Insulin, leptin, growth hormone and thyroid hormones are the hormones play important role in obesity.
3. **Android or Central Obesity**
 - a. This type of obesity is characterized by the accumulation of excess fat primarily in the abdominal area, resulting in an "apple-shaped" body.
 - b. It is more common in women.
 - c. It is associated with an increased risk of cardiovascular disease, diabetes, and metabolic syndrome.

Gynoid or Peripheral Obesity

- a. This type of obesity is characterized by the accumulation of excess fat predominantly in the hip and thigh region, resulting in a "pear-shaped" body.
- b. It is more common in women.

c. It is generally considered less detrimental to health compared to central obesity.

Check Your Progress Exercise 2

1. The method is commonly used to identify underweight individuals include:
 - Body Mass Index (BMI): BMI is a widely used screening tool that calculates weight in relation to height. A BMI below 18.5 is generally considered underweight.
 - Body composition analysis: This assessment measures the proportion of fat, muscle, and other tissues in the body. It can provide a more accurate understanding of an individual's body composition and identify low muscle mass.
 - Clinical evaluation: Healthcare professionals may conduct a physical examination and review medical history to identify signs of undernutrition or underlying health conditions that contribute to being underweight.
2. Common symptoms of underweight individuals include unexplained weight loss, fatigue, lack of energy, decreased muscle strength, weakened immune system, frequent illnesses or infections, delayed wound healing, brittle hair and nails, and irregular or absent menstrual periods in females. Other symptoms may include poor concentration, dizziness, difficulty regulating body temperature, and changes in mood or mental well-being. It's important to note that these symptoms can vary depending on the individual and may be influenced by factors
3. Dietary modifications for underweight individuals aim to increase calorie intake and provide a balanced nutrient profile. Focus on consuming nutrient-dense foods that are rich in proteins, carbohydrates and healthy fats. Include sources such as nuts, seeds, lean meats, fish, whole grains, legumes, dairy products, and healthy oils. Incorporate frequent meals and snacks throughout the day to boost calorie intake. Consider adding calorie-dense foods like ghee, nut butters, dried fruits, and whole milk. Additionally, stay hydrated and engage in regular physical activity to help stimulate appetite, build muscle mass and support healthy weight gain.

Unit 9 – NUTRITION IN HEPATIC PROBLEMS

Structure

- 9. 1 Introduction
- 9. 2 Structure of the Liver
- 9. 3 Functions of the Liver
- 9. 4 Jaundice
 - 9. 4. 1 Etiology of Jaundice
 - 9. 4. 2 Symptoms of Jaundice
 - 9. 4. 3 Diagnosis of Jaundice
 - 9. 4. 4 Nutritional Management of Jaundice
- 9. 5 Hepatitis
 - 9. 5. 1 Etiology of Hepatitis
 - 9. 5. 2 Symptoms of Hepatitis
 - 9. 5. 3 Diagnosis of Hepatitis
 - 9. 5. 4 Nutritional Management of Hepatitis
- 9. 6 Fatty Liver Disease: -
 - 9. 6. 1 Etiology of Fatty Liver Disease
 - 9. 6. 2 Symptoms of Fatty Liver Disease
 - 9. 6. 3 Diagnosis of Fatty Liver Disease
 - 9. 6. 4 Nutritional Management Of fatty Liver Disease
- 9. 7 Liver Cirrhosis
 - 9.7.1 Etiology of Liver Cirrhosis
 - 9.7.2 Symptoms of Liver Cirrhosis
 - 9.7.3 Diagnosis of Liver Cirrhosis
 - 9.7.4 Nutritional Management Of liver Cirrhosis
- 9. 8 Hepatic Coma
- 9. 9 Let Us Sum Up
- 9. 10 Check Your Progress

9. 1 INTRODUCTION

The liver is a central organ in the human body, essential for numerous physiological processes, including metabolism, detoxification, bile production, nutrient storage, and regulation of energy balance. Hepatic problems, such as acute liver failure, chronic liver diseases (including cirrhosis and non-alcoholic fatty liver disease), and infections like hepatitis, can severely compromise these functions, leading to systemic health challenges. These conditions often result in metabolic disturbances, nutrient deficiencies, and impaired detoxification, which exacerbate the

disease and its symptoms. Nutrition plays a pivotal role in the management of liver diseases, as it directly influences liver metabolism, supports tissue repair, and helps counteract complications such as muscle wasting, fluid retention, and encephalopathy. Tailored dietary interventions not only address nutrient deficiencies but also contribute to slowing disease progression, reducing inflammation, and enhancing overall patient outcomes. This chapter delves into the intricate relationship between nutrition and liver health, highlighting therapeutic strategies to optimize care in individuals with hepatic problems.

9.2 STRUCTURE OF THE LIVER

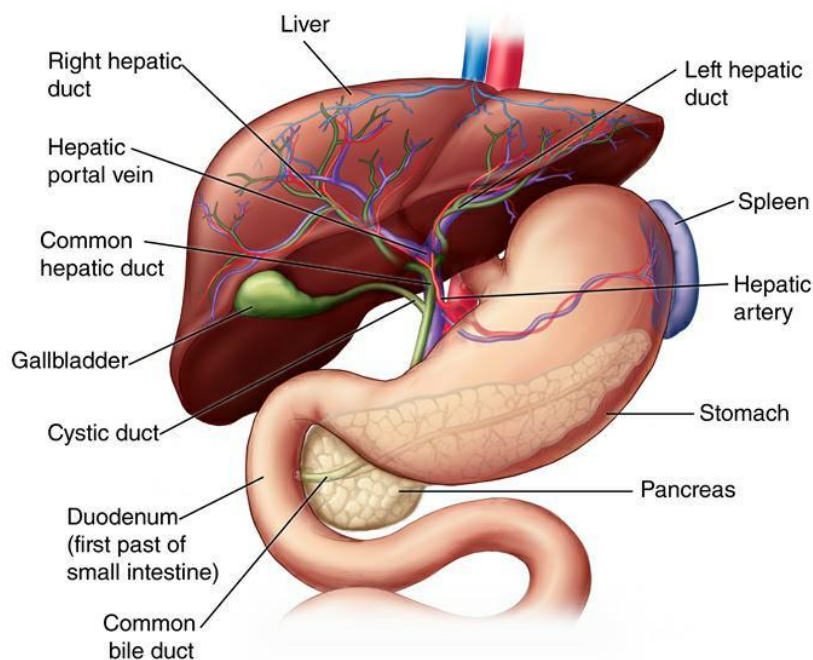
The liver is a beautifully designed organ and is located in the upper right side of the abdominal cavity, beneath the diaphragm, and is on top of the stomach, right kidney, and the intestines. The liver is an organ in the human body which is responsible for an array of functions which support major metabolism pathways, immune functions, digestion, detoxification, vitamin storage along with other functions. The liver is shaped like a cone; dark reddish-brown in colour that weighs about 3 pounds which is about 1360gm in a young healthy adult which comprises 2% of total body weight.

The liver is a uniquely designed organ due to dual blood supply from the portal vein (approximately 75%) and the hepatic artery (approximately 25%).

There are 2 sources that supply blood to the liver, as follows -

1. Oxygenated blood flows in via the hepatic artery
2. Nutrient-rich blood flows in via the hepatic portal vein.

The liver holds about 560ml (13%) of the body's blood supply. The liver consists of 2 main lobes. Both lobes are made up of 8 segments that consist of 1,000 lobules (small lobes). These lobules are connected to small ducts (tubes) which further connect with larger ducts to form the common hepatic duct, connected to the common bile duct. The common hepatic duct transports bile synthesis by the liver cells to the gallbladder and duodenum (first part of small intestine) via the common bile duct.



The functional unit of liver is called lobule. Each lobule is hexagonal in shape and a portal triad (portal vein, hepatic artery, bile duct) sits at each corner of hexagon. Foundation of lobules are composed of hepatocytes, that have physiologically distinct apical and basolateral membranes. On the basis of function and perfusion, hepatocytes are divided into 3 zones.

1. **Zone I** -The periportal region of hepatocytes and has the best perfused and very first to regenerate due to high availability of oxygenated blood and nutrients. Because of the high perfusion, zone I plays major role in gluconeogenesis, oxidative metabolisms such as beta-oxidation, bile formation, cholesterol formation, and amino acid catabolism etc.
2. **Zone II** -This zone is defined as pericentral region of the hepatocytes and zone II situated between zones I and III.
3. **Zone III** -Zone 3 has lowest perfusion due to distance from the portal triad. This zone plays the largest role in ketogenesis, detoxification, glycolysis, biotransformation of drugs, glutamine formation, lipogenesis, glycogen synthesis etc.

9.3 FUNCTIONS OF THE LIVER

The liver plays very vital role in nearly every organ system of the human body. Liver interacts with endocrine and gastrointestinal systems by supporting in digestion and metabolism. Liver is warehouse location of fat-soluble vitamins and handles cholesterol homeostasis along with storing iron and copper. Liver plays role in hematology by adding clotting factor and protein synthesis. It plays a role in heme breakdown into bilirubin and conjugates it. Liver plays a role in sex hormone metabolism and produces carrier proteins that are important in reproduction and development. Lastly but not least, the Kupffer cells and Pit cells play an important role in body's immunologic responses.

In this unique way liver plays more than 500 important functions in human body.

Bile Production: Bile is an important fluid in human body, it helps excrete waste which is not excreted by the kidneys and aids in digestion and absorption of fats and lipids via secretion of bile salts and acids. Bile is produced by hepatocytes which mainly consist of water, electrolytes, cholesterol bile salts, bile acids, pigments, bilirubin, phospholipids and in addition to other substances. Bile is ending up in the duodenum and being stored in the gallbladder. Bile performs its functions in bowel, and bile components which are not excreted are recycled as conversion into bile acids by gut bacteria for reuse by absorption in the ileum and transport back to the liver.

Fat-Soluble Vitamin Storage and/or Metabolism: Fat-soluble vitamins reach to the liver by intestinal absorption in the form of chylomicrons or very low density lipoproteins (VLDL). Liver stores and if required metabolizes fat-soluble vitamins. Even vitamin D3 comes from the skin, fortified foods like animal products and plant products, this must undergo 25-hydroxylation by the hepatic CYP-450 system. Liver receives vitamin E in its alpha and gamma-tocopherol forms. Alpha-tocopherol is integrated with very low density lipoproteins/high density lipoproteins in liver and then secreted back into circulation. Vitamin K is not stored or metabolized in liver, but presence of vitamin K is essential as liver enzyme i. e. gamma-glutamyl carboxylase requires it for gamma-carboxylation for coagulation factors like II, VII, IX, X, protein C and protein S.

Drug Metabolism: Liver performs a very critical function of metabolism and detoxification of drugs by using lysosomes. As major route of metabolism and detoxification is through biotransformation. These reactions take place mainly in smooth endoplasmic reticulum of hepatocytes. Other organs like kidney and gut also helps in drug metabolism but liver is major organ to work on detoxification of drugs.

Bilirubin Metabolism: Liver plays very significant role in breakdown of heme. Hemolysis takes place at multiple sites throughout body, like in liver, spleen, and bone marrows. Liver receives unconjugated bilirubin bound to albumin from the circulation. Liver works on unconjugated bilirubin; the newly conjugated bilirubin is secreted through bile canaliculi into bile or small amounts dissolve in blood here it gets filtered for excretion by kidneys. Major conjugated bilirubin enters in bile and is excreted with bile through feces as conjugated bilirubin which is not absorbed by the intestine.

Other Major Functions: As liver plays more than 500 functions in human body, some major functions are -

- Liver plays a role in thyroid hormone function as the site of deiodination of T₄ to T₃.
- Liver manages to synthesize nearly all the plasma protein in the body, some are named as albumin, binding globulins, protein C, protein S, all the clotting factors of the intrinsic and extrinsic pathways.
- Cholesterol and special proteins synthesis help carry fats throughout the body.
- Liver converts excess glucose into glycogen for storage (glycogen later can be converted back to glucose for energy) and balance it to make glucose available when needed by body.
- Liver regulates blood levels of amino acids, which forms the building blocks of proteins.
- Liver converts ammonia to urea (as urea is end product of protein metabolism and is excreted in urine).

9.4 JAUNDICE

Jaundice is very common condition that affects infants, children, and adults. Jaundice is the term used to define the state of body where yellowing of the skin and whites of the eyes occurs. Jaundice may occur when blood contains an excess of the pigment called bilirubin, a natural product arising from normal breakdown of red blood cells (RBCs) in body and excreted through bile by the liver.

As bilirubin gets generated in our body, the liver functions in maintaining the level of bilirubin in the body.

Red Blood Cells (RBCs) is a blood component that carry oxygen to various parts of the human body. RBCs are expected a lifespan of 3 to 4 months. After reaching their lifespan, RBCs are broken down and removed from circulation by special cells called phagocytes. RBC on breaking down may get separated into amino acids, iron, and bilirubin, out of these amino acids and iron are useful to body, whereas bilirubin needs to be excreted out from the body.

Waste products from body get excreted either through the kidney in the form of urine or through the liver in form of bile. When bilirubin is formed from RBC breakdown, it passes through blood to liver, where bilirubin gets converted into bile juice. Bile juice comes out of liver and then joins first part of the small intestine. It then passes through small and large intestine and gets expelled out with stool. Due to the disturbance in this process, amount of bilirubin inside body can increase and turn the skin color to yellow known as jaundice.

9.4.1 ETIOLOGY OF JAUNDICE

The inability of body to expel out the bilirubin leads to jaundice. There are several causes which suddenly or over the time period makes the bilirubin to pile up inside body. The main causes of Jaundice are:

- Higher rate of RBC breakdown resulting from prevailing health issues, such as infections like

malaria, sickle cell anemia, Gilbert syndrome etc.

- Viral infections of the liver and from prolonged exposure to harmful substance, such as alcohol and drugs.
- Obstructive jaundice is resulting due to an interruption in drainage of bile in biliary system. This could be due to pancreatic malfunction or the presence of a gallstone in the common bile duct.
- Pancreatitis could be a cause also.

9. 4. 2 SYMPTOMS OF JAUNDICE

Common symptoms which a patient suffering from jaundice experiences is:

- Yellow discoloration of the eyes, skin and gums
- Fever, chills
- Abdominal pain
- Flu-like symptoms
- Darkcolored urine.
- Palecolored stool.
- General fatigue.
- Loss of appetite
- Weight loss.



9. 4. 3 DIAGNOSIS OF JAUNDICE

Provisional Diagnosis can be made as the onset of jaundice from primary symptoms exhibited by patient. The patients have to undergo certain laboratory tests like -

1. **Blood Test-** Blood tests help to check the level of bilirubin in blood. Bilirubin levels above the acceptable norms are an indication of jaundice.
2. **Urine Test-** Urine test helps in identifying the level of urobilinogen. In the digestive system, as bacteria break down bilirubin, this leads to production of urobilinogen.

9. 4. 4 NUTRITIONAL MANAGEMENT OF JAUNDICE

Nutritional management plays a very crucial role in the treatment of jaundice and even post jaundice rehabilitation. Improving health of the liver is prime aim here.

Nutritional assessment: Nutritional assessment is a systematic process of collecting and understanding then interpreting information in order to make decisions about nature and cause of nutrition related health issues that affect an individual and disease related outcome (British Dietetic Association, BDA).

Assessment such as height or weight, as well as the fat mass composition of the human body to provide information about a person's nutritional status.

Objectives:

- To know the significance of nutritional assessment.
- Identify factors which affect nutritional status of individuals.
- Identify challenges in nutritional assessment.
- Summarize the role of nutritional assessment in relation to disease.

Easy way to remember types of nutrition assessment is ABCD:

A for Anthropometric: Some of common anthropometric measurements includes height, weight, body mass index (BMI), waist-to-hip ratio (WHR), head circumference skinfold measurements etc.

B for Biochemical: Biochemical or laboratory methods for assessment of nutrient and its metabolites in blood, faces, urine and other tissues that have a relationship with the nutrient. Example is measuring blood glucose level in diabetes patients.

C for clinical: Clinical methods of nutritional assessment involve checking signs of deficiency at specific places on the body like skin, hair, tongue, lips etc or asking patient whether they have any symptoms that might suggest nutrient deficiency. For example, bleeding gums in case of vitamin C deficiency and muscle loss in protein deficiency.

D for dietary: Anthropometry is measurement of the size, weight, and proportions of the body and finding BMI and WHR etc according to height and age.

Subjective global Assessment (SGA) proforma can be used to assess nutritional status as this type of SGA is globally accepted. Refer the given proforma for example –

Patient Name: _____ Patient ID: _____ Date: _____

Part 1: Medical History

1. Weight Change

A. Overall change in past 6 months: _____ kgs.

B. Percent change: _____ < 5% loss
gain - _____ 5-10% loss
10% loss _____ > 10% loss

C. Change in past 2 weeks: increase _____
no change _____
decrease _____

2. Dietary Intake

A. Overall change: _____ no change
_____ change

B. Duration: _____ weeks

C. Type of change: _____ suboptimal solid _____ full liquid
diet _____ hypocaloric liquid _____ diet
starvation

3. Gastrointestinal Symptoms (persisting for >2 weeks)

_____ none _____ nausea _____ diarrhea _____ anorexia
_____ vomiting _____

4. Functional Impairment (nutritionally related)

A. Overall impairment: _____ none
_____ moderate
_____ severe

B. Change in past 2 weeks: _____ improved
_____ no change
_____ regressed

SGA Score

	A	B	C
1. Weight Change			
2. Dietary Intake			
3. Gastrointestinal Symptoms			
4. Functional Impairment			
5. Evidence of:			
6. SGA Rating			

Part 2: Physical Examination

5. Evidence of: Loss of subcutaneous fat
Muscle wasting
Edema
Ascites (hemo only)

SGA Score

	Normal	Mild	Moderate	Severe
Loss of subcutaneous fat				
Muscle wasting				
Edema				
Ascites (hemo only)				

Part 3: SGA Rating (check one)

A. Well-Nourished B. Mildly-Moderately Malnourished C. Severely Malnourished

Diet for jaundice may vary depending on severity of jaundice and the underlying medical conditions. At a glance the ideal diet one needs to follow during jaundice treatment and rehabilitation can be followed as-The foods and drinks to consume by patients having jaundice includes:

Water – Fluids: One of the very important ways to recover from jaundice is to stay well hydrated. Water helps in quick digestion and helps in flushing out bilirubin from the kidney and liver. It is recommended to drink at least 3 litres of water or more per day. People find the taste of water to be bland. In this case, they can add a teaspoon of fresh lemon, lime or mint juice to water. This provides in an extra dose of antioxidants.

Fruits and vegetables: Fresh fruits and seasonal vegetables also support liver because as these contain fibre and powerful antioxidants. Fruits and vegetables also help in digestion. They also contain liver-friendly nutrients. leafy green vegetables are ideal for jaundice patients, starchy vegetables, such as potatoes, beets and pumpkins, etc. Legumes, such as

beans, peas, lentils, etc. fresh fruits, such as oranges, lemon (citrus fruits), banana, apples, pears and peaches, etc.

Eat Meat and Fish: Poultry such as lean chicken, egg whites are good for the patients rehabilitating from jaundice. fish are also good for patients suffering from jaundice. Avoid red meat and preparations during the peak jaundice.

Dairy Products: Low fat milk are ideal for jaundice patients. Curd and paneer are also preferred milk products of low fat for better digestion and tolerance.

Drink Beverages: Jaundice patients need to keep themselves well hydrated. Make sure that you have more than 10 to 12 glasses of water. Unsweetened juices, plain water, green tea, or black coffee are ideal beverages that can be consumed. Make sure to avoid coffee or caffeine-based items more than 2 servings per day.

Avoid Alcohol: Patients need to completely avoid alcohol with jaundice and other liver-related problems.

Nutritional management becomes more important in jaundice than any other disease. A balanced and high protein diet helps in the early recovery and better prognosis of liver and its associated functions.

<i>Foods to be Included in Diet</i>	<i>Foods to be Taken in Moderate Amounts</i>	<i>Foods to be Avoided</i>
-Daily include 10-12 glasses of water every day. -Fresh fruits and vegetables need to be consumed. -Include melons and fenugreek seeds. - Include boiled egg whites. -Can include dals, rice and millets which are good in jaundice. -Can include freshly made fruit juice. -Include low fat milk, curd and buttermilk.	-Multigrain whole flour products like bread, pasta, noodles. -Soybeans and products like soybean milk and paneer. -Green leafy vegetables, radish, brinjal, beans, capsicum and beetroot -Mangoes -Lean chicken and fish -Almonds and walnuts in limit.	-Avoid red meat. -Avoid full fat milk and products. -Avoid deep fried foods and spicy foods -Avoid too much sweets and desserts. -Avoid too much coffee, tea which can cause more inflammation. -Avoid alcohol. -Avoid refined sugar.

9.5 HEPATITIS

Hepatitis is usually an inflammation of liver. Inflammation is swelling of hepatocellulars that happens when tissues of liver are injured or infected. Swelling is known as hepatitis which damages the functioning of liver. Variety of viral infections leads to hepatitis and liver damage. Hepatitis viruses A, E is a major cause of acute hepatitis which may not result in chronic hepatitis, though hepatitis E can lead to fulminant hepatitis in pregnant women.

9.5.1 ETIOLOGY OF HEPATITIS

Hepatitis A and E can be seen in travelers because of consumption of contaminated water or seafood sources. These two types of hepatitis are usually self-limiting illnesses with the symptoms of jaundice and vomiting.

Whereas hepatitis B, C, and D are viruses that causes acute hepatitis that can result in chronic hepatitis. Hepatitis D relies on hepatitis B as reproduction. Hepatitis D can either occur at the same time as hepatitis B, which is called co-infection, or at same time top of hepatitis B, called superinfection which is very dangerous so timely diagnosis is must.

Hepatitis B and C can occur from contaminated needles, from pregnant mother to foetus, in tattooing, intravenous drug use, and Hepatitis B is a sexually transmitted disease.

- Alcoholic hepatitis is caused by chronic alcohol uses.
- Toxic hepatitis - caused by certain poisons, chemicals, medicines and even by supplements also.
- Autoimmune hepatitis- is a chronic type of hepatitis where body's immune system attacks liver.

The treatment against hepatitis A, B, and C is vaccination.

9.5.2 SYMPTOMS OF HEPATITIS

Hepatitis can be acute or chronic infection but some type of hepatitis can cause only acute infections. Many people with hepatitis do not have major symptoms so they do not know why they are infected, symptoms include:

- Fever
- Fatigue
- Joint pain
- Loss of appetite and weight loss
- Nausea and vomiting
- Jaundice – yellow colour eyes and skin
- Abdominal pain
- Dark colour urine
- Clay colour bowel movements

In acute infection, symptoms can start anywhere between 2 weeks to 6 months after infection. In chronic infection, person may not have symptoms until years later.

9. 5. 3 DIAGNOSIS OF HEPATITIS

To diagnose of hepatitis, physician or gastroenterologist will take detailed history

- May ask about symptoms and medical history
- Will do a physical examination
- Likely perform blood tests, including tests for viral hepatitis
- Lately ultrasound and CT scan or MRI can be performed for final diagnosis.
- Some times need to do a liver biopsy to get clear diagnosis and to check for liver damage.
- The IgG is a marker that shows vaccination or prior exposure, whereas IgM shows acute infection. There have been advancements in the treatment of hepatitis C.

9. 5. 4 NUTRITIONAL MANAGEMENT OF HEPATITIS

Treatment for hepatitis depends on type and whether it is acute or chronic. Person with hepatitis may just need to take rest and get enough fluids. But in some cases, it may be more serious so may need to get hospitalized.

People with alcoholic hepatitis need to stop alcohol consumption along with nutritional management. Impairment of liver function due to hepatitis causes malnutrition, as liver is one of the most important organs involved in metabolism, digestion, absorption and overall nutritional homeostasis. So nutritional support can restore impaired liver function and improve prognosis in patients with hepatitis.

Principles of Nutritional Management are as follows

1. Firstly, maintain the body weight and then achieve the ideal body weight (in case of weight loss).
2. Provide adequate calories and high protein intake of high biological value for liver support and synthesis of important body proteins.
3. Moderate fats and lipids for energy and to support metabolic processes.
4. Adequate vitamins and minerals
5. Fibre and adequate fluids.

Nutritional Recommendations for Hepatitis:

Energy: 30-35kcal/kg body weight (upto 40kcal/kg body wt can be given).

Protein: 1.0-1.2g/kg body weight (if protein tolerance is good then 1.5g/kg body weight can be allowed).

Carbohydrates: 55-60% of total energy

Fat: upto 15% of total energy

B-complex, vitamin C and vitamin E and vitamin K and zinc is required while planning a diet for hepatitis patients.

Adequate fluids.

Progress after tolerance to small and frequent feedings.

Hepatitis diet choices are not limited to few bland dishes and foods. There are plenty of healthy choices, tasty food options which are nutritious for the liver and for the recovery process too.

- Whole grains are very beneficial to consume as part of a healthy hepatitis diet. These can be in the form of bran, whole wheat bread or cereal, brown rice, whole grain pasta or porridge. Include other whole grains such as whole oats, wild rice, rye, oatmeal and corn.
- Fruits and vegetables should be a significant part of any diet to help in recovering from a liver disease. They are full of essential nutrients and are easy to digest. As a bonus, they also contain antioxidants, which can protect the liver cells from damage. However, it is recommended that one go easy on starchy vegetables such as potatoes when on a Hepatitis recovery diet. While canned or frozen fruits are fine, it is always a good idea to try and eat fresh and seasonal produce whenever possible.
- Olive oil, canola oil and flaxseed oil are all healthy fats that are recommended as part of a diet for patients with hepatitis.
- Healthy proteins in the form of low-fat milk and dairy product along with lean meats, beans, eggs and soy products can also be a part of a healthy liver diet.

Refer below for Quick tips -

- Stay hydrated- water, coffee, or butter milk can support hydration and liver function.
- Eat a variety of fresh fruits and seasonal vegetables every day.
- Look for high fiber foods, like oatmeal, whole grains, cucumber, broccoli, chickpeas, lentiles, berries, and mix nuts.
- Eat variety of proteins of high biological value and choose lean cut meat of animals.
- Maintain ideal body weight.
- Avoid alcohol.

9.6 FATTY LIVER DISEASE

Fatty liver is defined as a condition where more than 5% fat inside liver affects functioning of liver and causes liver injury. Person who drinks too much alcohol may also have fat inside liver, but that condition is different from fatty liver disease. But one can get fatty liver disease whoeven don't drink a lot of alcohol.

Types of fatty liver disease:

Clinically fatty liver disease can be divided into two types.

1. If a person with just fat more than normal but no damage to liver, the disease is called nonalcoholic fatty liver disease (NAFLD).
2. If person with fat in liver plus signs of inflammation and damage to liver cells the disease is called nonalcoholic steatohepatitis (NASH).

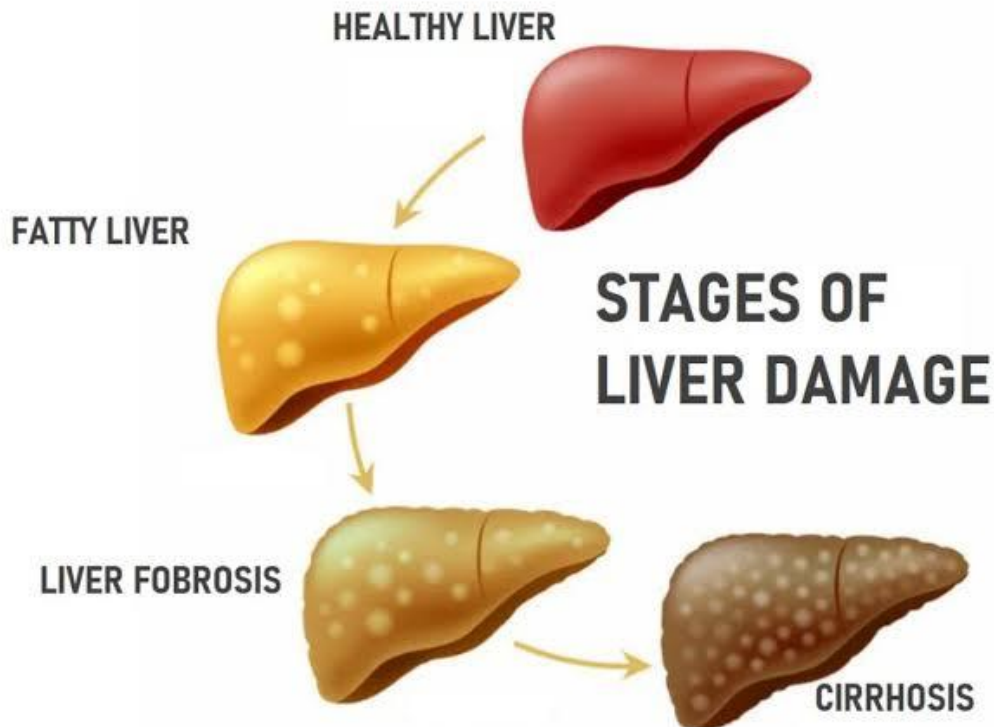


Image for reference of stage and progression of liver disease.

9. 6. 1 ETIOLOGY OF FATTY LIVER DISEASE

When it is alcoholic liver disease, the cause is too much alcohol and other causes are -

- High BMI or being over weight.
- Protein calorie malnutrition
- Chronic viral hepatitis
- Genes that are more likely to get it - genetics
- Age – 35 year or more are more likely to get fatty liver.
- Large waist size
- High cholesterol
- Low levels of HDL (good) cholesterol
- High blood pressure
- High blood sugar levels etc.

9. 6. 2 SYMPTOMS OF FATTY LIVER DISEASE

Liver disease sometimes is called silent liver disease. As it can happen without causing any symptoms. Most people with NAFLD live with fat in liver without developing any liver damage. Few people who have fat in their liver develop NASH – non alcoholic steatohepatitis. If one has steatohepatitis may have symptoms that could take years for them to develop. If liver damage from NASH leads to permanent scarring and hardening of liver, this is called cirrhosis.

Symptoms from NASH may include:

- Tiredness, fatigue
- Weakness
- Weight loss
- Yellowing of the skin or eyes
- Spiderlike blood vessels on the skin
- Itching all over body.

NASH that turns into cirrhosis could cause symptoms like fluid retention, internal bleeding, muscle wasting, and confusion. People with cirrhosis over time may develop liver failure and need a liver transplant.

9. 6. 3 DIAGNOSIS OF FATTY LIVER DISEASE

Informations can help doctors to diagnose non alcoholic fatty liver disease.

1. **Physical examination:** – Body weight, waist circumference for signs of liver problems such as enlarged liver or jaundice.
2. **Blood tests:** These can show if one has high levels of liver enzymes such as alanine aminotransferase (ALT) and aspartate aminotransferase (AST). If so, there could be a problem with your liver.
3. **Ultrasound:** Studies on liver may show fat deposits. Some imaging tests like fibro scan and MRI scans can help diagnose the disease and spot scar tissue in the liver. The only way to confirm that fatty liver disease is the only cause of liver damage is through liver biopsy and histopathological study.

9. 6. 4 NUTRITIONAL MANAGEMENT OF FATTY LIVER DISEASE

Principles of Nutritional Management are as follows

1. To reduce the body weight and then maintain the ideal body weight (in case of over weight and obese).
2. Provide low calories and high protein of high biological value to preserve lean muscle mass.
3. Restrict carbohydrates and simple sugars to cut on total calories.
4. Low fats and lipids for energy and to support metabolic processes.
5. Adequate vitamins and minerals
6. High fibre and adequate fluids.

Nutritional Recommendations for NAFLD:

- Energy: 20-25kcal/kg body weight.
- Protein: 1.0-1.2g/kg body weight
- Carbohydrates: 50-55% of total energy
- Fat: upto 15% of total energy
- B complex, vitamin C and vitamin E and vitamin K and zinc is required while planning a diet for NAFLD patients.

- Adequate fluids.
- High fibre, small frequent meals and in between free foods for satiety.

Lifestyle changes:

- **Eat healthy food-** Choose a plant-based diet with lots of fruits, vegetables, whole grains and healthy fats in moderation.
- **Stay at healthy weight-** Lose weight if over weight. If weight is ideal, work to maintain it by choosing a healthy diet and exercising.
- **Exercise-** Make physical activity a regular habit. Try to be active at least 30 minutes a day most days of the week. Try losing weight if over weight.
- **Be kind to liver** - Avoid alcohol, take advised medications and over-the-counter drugs only as instructed by physician.
- **Reduce cholesterol level-** A plant-based diet, exercise, and medications helps in keeping cholesterol and triglyceride levels where they need to be.
- **Manage blood sugars or insulin resistance** – Simple Carbohydrate restrictions along with physical activity and take medications prescribed by doctor.

Refer below the food list advised for NADLD (Nonalcoholic fatty liver disease)

<u>What foods should you eat</u>	<u>What foods should you not eat</u>
• Expert recommends the Mediterranean diet to individuals with fatty liver disease. • The Mediterranean diet emphasizes on high intake of vegetables, fruits, and healthy fats. • Liver-friendly diet includes whole grains, nuts, and legumes. • Lean meats should be consumed in moderation and red meats should be totally avoided. • Sweets and added sugars should be limited.	• Sugary beverages like soda, juice, lemonade, and sports drinks should be avoided. • Red meats, bacon, and other processed meats should be limited in the diet. • Butter should also be limited, and foods containing trans fats like fried foods, such as french fries, fried chicken, and doughnuts, processed snacks, such as crackers and chips and baked goods, such as cakes, cookies, and pastries should be avoided completely.

Tips to the NADLD/Fatty Liver Diet

1. Focus on whole grains, plant-based diet: Include 5-7 servings of vegetables, fruits and 7-8 servings of whole grains, 1 serving of nuts, and 2 serving of legumes in daily diet. Such combination foods are rich in fibre, vitamins, and minerals, and low in saturated and trans fats, which can be beneficial for individuals with fatty liver disease.
2. Limit processed foods, such as fast food, snacks, and bakery products, often contain high amounts of sugar, unhealthy fats, and additives that can worsen the grade of fatty liver disease. Junk food contains high levels of fructose, trans and saturated fats and high fructose corn

syrup, which increases the amount of fats.

3. Choose lean protein: Choose lean protein sources such as low-fat paneer, curd, skinless poultry, fish, beans, and lentils over red meats.
4. Avoid sugar and Products - Sugary beverages like soda, juice, lemonade, and sports drinks and other sugary and carbonated beverages contain high amounts of fructose and other sugars. When these kinds of sugars are taken in high amounts they are processed in liver and converted into fat, leading to the accumulation of fat in liver cells. So, it's better to opt for water, buttermilk, unsweetened tea, or coffee.

Check portion sizes: Overeating leads to weight gain and increase risk of fatty liver disease. Be mindful for portion sizes and consider using smaller plates and bowls to help control portions. Large portion sizes contribute to weight gain and obesity, which are risk factors for fatty liver disease. When one eats more calories than our body needs, the excess calories are supposed to be stored as fat in liver and other sites of body, leading to the development of fatty liver disease.

5. Stop or Limit alcohol consumption: Drinking alcohol in excess damages the liver and exacerbates fatty liver disease. If one chooses to drink, do so in moderation that too on occasionally. Complete abstinence from alcohol, especially for those with alcoholic fatty liver disease is a way to reverse NAFLD.
6. Exercise: Regular physical activity 30 minutes a day or 150 minutes per week is essential and can aid in weight loss, improves insulin sensitivity, a decreased risk of fatty liver disease.

Important Note – Counselling for a simple lifestyle change can help a long way in preventing and even reversing NAFLD/ fatty liver disease.

Sample meal plan For Fatty Liver

Morning—1 glass Lukewarm water (with or without lemon)

30–45 minute brisk walk/cycling/swimming/jogging etc.

1 cup tea (skimmed milk and no sugar).

Breakfast:

1. 2-Besan chilla made with gram flour, onion, tomato, capsicum, green chutney/2 Chapati + 1 bowl vegetables/ 1 bowl dalia/ 1 bowl upma/poha
2. 150ml curd/milk (skimmed milk)
3. 2 egg whites (boiled)/50 gm paneer (fat free)

Mid Morning:

11. 30am- Buttermilk 150-200ml+ a handful of mixed nuts.

Lunch:

2 chapatis + ½ bowl rice

1 bowl -Dal (thick)

1 bowl vegetables

1 bowl curd (fat free 150ml -raita)

1 plate salad

Evening:

4. 30-5. 00pm – Roasted Chana 40gm/makhana (fox nuts)+ green tea/100ml butter milk.

Dinner:

1-2 chapati + roasted vegetables and dal.

Bed Time:

150-200 ml milk.

Important Note -All requirement needs to be calculated on the basis of individual's weight, height, age, sex and lifestyle type i. e. sedentary, moderate etc. Then distribute the macro and micro nutrients accordingly and choose portion size as per requirement and follow recommendations of ICMR (Indian Council of Medical Research) and calculate RDA(Recommended dietary allowances).

Flexibility and exchange list need to be considered while planning diet for any disease patients.

9. 7 LIVER CIRRHOSIS

Cirrhosis is a progressive clinical condition when scar tissues gradually replace healthy liver cells. Cirrhosis is final stage due to various chronic liver diseases after years may be decades of slow progression. There are effective ways to prevent cirrhosis, because several measures are available to prevent and treat this condition.

9. 7. 1 ETIOLOGY OF LIVER CIRRHOSIS

Underlying disease may be chronic hepatitis B and C, other chronic viral hepatitis, fatty liver disease due to any of the very common underlying disorders i. e. obesity, diabetes and chronic alcohol abuse which commonly progresses to cirrhosis if untreated.

Common causes of cirrhosis are: -

- Hepatitis and other viruses
- Alcohol abuse for long time
- Nonalcoholic fatty liver disease /NAFLD (this is associated with metabolic syndrome such as obesity, high cholesterol, triglycerides and high blood pressure etc)

Other less common causes of cirrhosis may include:

- Autoimmune disorders.
- Use of certain medicines and toxins.
- Exposure to certain toxic chemicals.
- Parasite infections.

9. 7. 2 SYMPTOMS OF LIVER CIRRHOSIS

Symptoms may vary, depending on how severe cirrhosis is as mild cirrhosis may or may not cause any symptoms at all.

What are the symptoms of cirrhosis?

Symptoms may vary, depending on how severe cirrhosis is. Mild cirrhosis may not cause any symptoms at all.

Symptoms may include:

- Muscle loss
- Loss of appetite
- Itching
- Yellowing of the skin and eyes (jaundice)
- Vomiting blood from bleeding blood vessels in food pipe (esophagus)
- Easy bruising
- Spider-like veins in the skin
- Low energy and weakness (fatigue)
- Weight loss
- Fluid buildup in belly (ascites)
- Confusion as toxins build up in the blood (hepatic coma)

9. 7. 3. DIAGNOSIS OF LIVER CIRRHOSIS

1. Blood tests: -There are several numbers of liver function tests to see if the liver is working the way it should be.
2. Ultrasound: This imaging test scans internal organs as how they are working. For this test machine uses high-frequency sound waves and a computer to create images of organs and related blood supply system around.
3. Liver biopsy: Small tissue samples can be taken from liver with a needle or during surgery. Then the samples are checked under microscope to find out type of liver disease.
4. CT scan (computed tomography). This imaging test uses X-rays and a computer to create data on bones, muscles, fat, and organs.
5. MRI (magnetic resonance imaging). Through this test detailed picture of organs and structures inside the body is studied. For MRI imaging magnetic field and pulses of radio wave energy is used.
6. Endoscopy (EGD). Lighted flexible camera is placed through mouth into upper digestive tract to check for enlarged blood vessels if those are at risk of bleeding because of cirrhosis.

9. 7. 4 NUTRITIONAL MANAGEMENT OF LIVER CIRRHOSIS

Principles of Nutritional Management are as follows

1. Maintain the ideal body weight (in case of weight loss and or muscle loss)
2. Advised for high calorie and high protein of high biological value to ensure adequate calorie and protein to preserve lean muscle mass.
3. Advised for high carbohydrates diet for instant energy (carbohydrate to be chosen sensibly if patient is suffering from cirrhosis along with diabetes).
4. Moderate fats and lipids for energy and to spare protein for body building and amino acid synthesis.
5. Adequate vitamins and minerals (sodium restricted diet if ascites is present)
6. High fibre and adequate fluids.
7. Small and frequent meals.

Nutritional Recommendations for Liver Cirrhosis:

- Energy: - 30-35kcal/kg body weight (upto 40 kcal can be advised if tolerating)
- Protein: - 1.0-1.2g/kg body weight (upto 1.5g/kg body weight if tolerating)
- Carbohydrates: - 55-60% of total energy
- Fat: - upto 15% of total energy from good quality fat MUFA and PUFA.
- B-complex vitamins, vitamin C, vitamin E, vitamin K and zinc is need to be considered while planning a diet for hepatitis patient.
- Adequate fluids (restrict fluids and sodium after discussion with treating consultant).
- High fibre small, frequent meals in between free foods for satiety.

Sample meal plan for Cirrhosis patients

Morning:

1 glass lukewarm water (with or without lemon)

1 cup tea/coffee/lassi/milk shakes (use at least 200ml milk)

Breakfast:

1. 3-Besan chilla made with gram flour, onion, tomato, capsicum+ green chutney/3

Chapati + 1 bowl vegetables/ 2 bowl dalia/ 2 bowl upma/poha

2. 200ml curd/milk (toned condensed milk)

3. 3-4 egg whites (boiled)/ 80 gm panner (appropriate Protein supplements can be taken)

Mid Morning:

11. 30am – 50gm channasattu/dal halwa/home made protein bar+ small seasonal fruit

Lunch:

3-4 Chapati + ½ bowl rice

1 bowl -Dal (thick)

1 bowl vegetables

1 bowl curd (fat free 150ml / 50gm panner)

Salad+lemon

Evening:

4. 30-5.00pm – Roasted Channa 50gm/ sattulassi/2egg omelette+ tea/coffee (with added milk)

Dinner:

3 chapati + vegetables and dal (thick)/chicken /fish curry

Bed time:

Milk (condensed) + Dry fruit powder/Protein supplement.

Important Note -All requirement needs to be calculated on the basis of individual's severity of disease, weight, height, age, sex and lifestyle type i. e. sedentary, moderate etc. Then distribute the macro and micro nutrients accordingly and choose portion size as per the requirement and recommendations of ICMR (Indian Council of Medical Research), RDA (Recommended Dietary

Allowances).

Flexibility and exchange list need to be considered while planning diet for any disease patients.

As cirrhosis is a progressive disease that happens over time. The damage to liver can sometimes reverse or improve if one stops drinking alcohol or if the virus is completely treated.

The nutritional goal is to support medical treatment and slow down the buildup of scar tissue, prevent or treat other related issues.

In many cases, patient may be able to delay or stop any more liver damage.

Tips to follow for healthy liver

1. Follow a healthy lifestyle.
2. Eating a healthy high protein diet, low in sodium.
3. Not having alcohol or self medication
4. Consulting doctor on time regarding any health problems that happened because of cirrhosis.
5. Consult to healthcare provider before taking medicines, over-the-counter medicines, or vitamins.

9.8 HEPATIC COMA

Liver synthesizes most of body proteins by amino acids absorbed from the digestive system. Protein degradation generates free amino acids, which may be transaminated and deaminated that produces ammonia. Ammonia is a toxic metabolite which is effectively removed from the circulation via hepatic conversion to urea, which is then eliminated in urine by kidneys. But when liver function is impaired, hyperammonemia occurs which increases the chances of developing hepatic encephalopathy.

As Ammonia is generated from protein breakdown still clinical studies suggest Vegetable proteins are best tolerated, followed by proteins contained in dairy foods, milk and curd. Vegetables protein sources are thought to be beneficial because of high fibre content as fibre promotes bacterial fermentation and decreases colonic transit time that decreases ammonia absorption from gut, but also because of their high branched chain amino acid content.

European Society of Parenteral and Enteral Nutrition (ESPEN): Guidelines increased the protein requirements of cirrhotic patients and recommended 1.2 g of protein per kg body weight/day. Guidelines state that hepatic encephalopathy should not be the reason to limit protein content of diet to 1-1.5 g of protein per kg body weight/day unless protein restriction is for very short time and is applied with BCAA-enriched amino acid supplements/solutions.

Liver cirrhosis patients should receive sufficient energy (35-40 Kcal/kg/d) to prevent degradation of endogenous protein for energy, and up to 1.6 g of protein per kg body weight/day.

Table 1. Source: What diet should I recommend my patient with Hepatic Encephalopathy?

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Jawaid Shaw, MD, FACP, Victoria Tate et al.

Comparison of the Macronutrient and Micronutrient Recommendations from various organizations

Organizations	Calorie Recommendation	Protein Recommendation	Micronutrient Recommendations	Remarks
ISHEN(12)	35–45 kcal/kg/day	1. 2–1. 5g/kg/day	MVI supplementation in decompensated cirrhosis, replete electrolytes like magnesium and sodium, IV Thiamine for WE	Uses Ideal body weight MVI's are safe and cheap to use sodium correction should be done slowly
AASLD(13)	35–40 kcal/kg/day	1. 2–1. 5g/kg/day	Use MVI's, replete deficient micronutrients, zinc supplementation for HE and thiamine for WE	Uses ideal body weight High dose IV thiamine for WE
EASL(1)	35 kcal/kg/day	1. 2–1. 5g/kg/day	Assess for vitamin D deficiency and if found treat accordingly	Uses actual body weight corrected to ascites Treat confirmed or suspected vitamin/micronutrient deficiency as per standard practice
ESPEN(14)	30–35 kcal/kg/day	1. 2–1. 5g/kg/day	Administer micronutrients for confirmed/suspected deficiency of Vitamin A & Zinc. Supplements improve dysgeusia and can improve dietary intake.	Does not specify whether to use actual or ideal body weight cautions to watch for refeeding syndrome

Abbreviations: International Society for Hepatic Encephalopathy, ISHEN; American Association for the Study of Liver Diseases, AASLD; European Association for the Study of the Liver, EASL; European Society for Clinical Nutrition and Metabolism, ESPEN; Multivitamins, MVI; Wernicke's Encephalopathy; WE, Hepatic Encephalopathy; HE, Intravenous, IV

Tips: - Dietary Rules for patients with Hepatic Encephalopathy

1. Eat frequent meals and snacks including snack before going to bed
2. Eat more protein upto 1. 1-1. 5g/kg body/day (do not restrict protein in hepatic coma stage).
3. Restrict sodium-Total 3gram salt/day- patients have fluid (ascites).

4. Stop drinking alcohol
5. Stay hydrated (if ascites is present discuss to doctor)
6. Don't start any supplements or herbal supplement without consulting hepatologist or a dietitian.
7. Exercise as tolerated will complement nutritional status.
8. Discuss dietary plan during the entire visits with hepatologist/dietician.
9. Adhering to diet plan as advised.

9.9 LET US SUM UP

In this unit, we examined the role of nutrition in managing hepatic problems, focusing on conditions that affect liver health. Starting with an introduction to the structure and functions of the liver, we explored how it plays a vital role in metabolism, detoxification, and nutrient storage. Specific liver conditions were discussed in detail, including jaundice, hepatitis, fatty liver disease, liver cirrhosis, and hepatic coma. For each condition, we covered their etiology, symptoms, diagnostic approaches, and nutritional management strategies. Emphasis was placed on the importance of tailored dietary interventions to support liver function, alleviate symptoms, and promote recovery. This unit underscores the critical role of nutrition in the prevention and management of hepatic disorders, providing students with comprehensive insights into the dietary care required for maintaining liver health.

9.10 CHECK YOUR PROGRESS

1. Conduct general nutritional assessment among students (using SGA for at least 10 students).
2. Prepare an exchange list of 5gm protein for each serving size.
3. Prepare a diet plan for jaundice, hepatitis and cirrhosis patient.
4. Learn and memorise recommended dietary allowances for Indians.
5. Prepare notes on liver functions and its role in metabolism referring to different sources.

UNIT-10 : NUTRITION IN RENAL DISEASES

Structure

- 10. 1 Introduction
- 10. 2 Structure of the Kidneys
- 10. 3 Functions of Kidney
- 10. 4 Kidney Failure
 - 10. 4. 1 Symptoms
 - 10. 4. 2 Diagnosis of Kidney Diseases
 - 10. 4. 3 Definition of PEM/PEW
 - 10. 4. 4 Goal of Dietary Management in Kidney Diseases
- 10. 5 Renal Calculi
 - 10. 5. 1 Symptoms
 - 10. 5. 2 Etiology of Renal Calculi
 - 10. 5. 3 Nutritional Management of Renal Calculi
- 10. 6 Nephrotic Syndrome
 - 10. 6. 1 Symptoms of Nephrotic Syndrome
 - 10. 6. 2 Dietary Goal in Nephrotic Syndrome
- 10. 7 Glomerulonephritis
 - 10. 7. 1 Symptoms of Acute Glomerulonephritis
 - 10. 7. 2 Symptoms of Chronic Glomerulonephritis
 - 10. 7. 3 Dietary Goal in Glomerulonephritis
 - 10. 7. 3 Dietary Goal in Glomerulonephritis
- 10. 8 Let Us Sum Up
- 10. 9 Check Your Progress

10.1 INTRODUCTION

The kidneys are vital organs responsible for maintaining the body's internal environment by regulating fluid balance, electrolytes, acid-base homeostasis, and the excretion of metabolic waste products. Renal diseases, including acute kidney injury (AKI), chronic kidney disease (CKD), and end-stage renal disease (ESRD), significantly impair these functions, leading to systemic imbalances and life-threatening complications. Nutritional management is a cornerstone in the care of individuals with renal disorders, as it plays a crucial role in mitigating disease progression, managing symptoms, and improving quality of life. Proper dietary interventions can help control blood pressure, reduce proteinuria, and manage metabolic disturbances such as hyperkalemia, hyperphosphatemia, and uremia, which are common in renal diseases. Moreover, the nutritional needs of patients vary based on the stage and type of renal dysfunction, requiring a personalized approach to macronutrient and micronutrient intake, fluid management, and dietary restrictions. This chapter explores the complex interplay between nutrition and kidney health, focusing on evidence-

based dietary strategies to support renal function and optimize patient outcomes across the spectrum of renal diseases.

10.2 STRUCTURE OF THE KIDNEYS

The human excretory system comprises of two kidneys, two ureters, urinary bladder and urethra. The kidneys (also known as retroperitoneal organs) are bean shaped; about the size of an adult fist, are located at the back of the abdominal wall between the level of the T12 and L03 vertebrae. In order to accommodate the liver, the right kidney is placed a little lower than the left kidney.

The kidneys have an outer convex surface and inner concave surface. The renal artery enters and the renal vein and ureter leave the kidney via a notch called hilum present at the inner concave side.

A thin fibrous connective tissue, **renal capsule** surrounds each kidney to protect them from infections and damages. A sheet of adipose tissue surrounds the capsule which is further enclosed by a layer of fibrous membrane known as **renal fascia**. The **cortex** is a reddish-brown layer of tissue below the capsule and comprises of renal corpuscles and convoluted tubules.

The **Medulla** is the innermost layer, consisting of conical areas called the **renal pyramids** separated by **renal columns**. The apex of each pyramid is called a **renal papilla**, and each papilla projects into a small depression, called a **minor calyx** (plural calyces). Several minor calyces unite to form a **major calyx**. The major calyces join to form a funnel shaped structure called **renal pelvis** that collects urine and leads to ureter. Nephrons flow between the renal cortex and inner renal medulla. Each nephron includes a filter, called the glomerulus, and a tubule. The glomerulus filters blood, which enters the kidneys through the renal arteries and leaves through the renal veins.

Each kidney has nearly one million complex tubular structures called **nephrons** (Figure 9. 1), which are the functional units. Each nephron has two parts – the glomerulus and the renal tubule. **The glomerulus** is a cluster of capillaries that absorb protein from blood traveling through the renal corpuscle. The renal tubule begins with a double walled cup-like structure called **Bowman's capsule**, which encloses the glomerulus. The remaining fluid, called capsular urine, passes through the Bowman capsule into the renal tubules. The tubule returns necessary substances to the blood and removes waste that then becomes urine.

Each tubule has several parts like proximal convoluted tubule, loop of Henle and **distal convoluted tubule** and collecting duct present at the end of each nephron in the renal medulla. Once in the collecting duct, the fluid moves on and finally stops in the renal pelvis.

In the innermost part of the kidney there is a funnel-shaped space known as renal pelvis. The first part of the renal pelvis comprises the calyces which are small cup-shaped spaces that collect fluid prior to it moves into the bladder. The renal artery brings oxygenated blood from the heart to the kidney whereas the renal vein carries filtered blood from the kidneys back to the heart. The ureters are urine-bearing tubes that exit the kidney and empty into the urinary bladder. Urine formation involves three main processes namely, glomerular filtration, reabsorption and secretion, that takes place in different parts of the nephron.

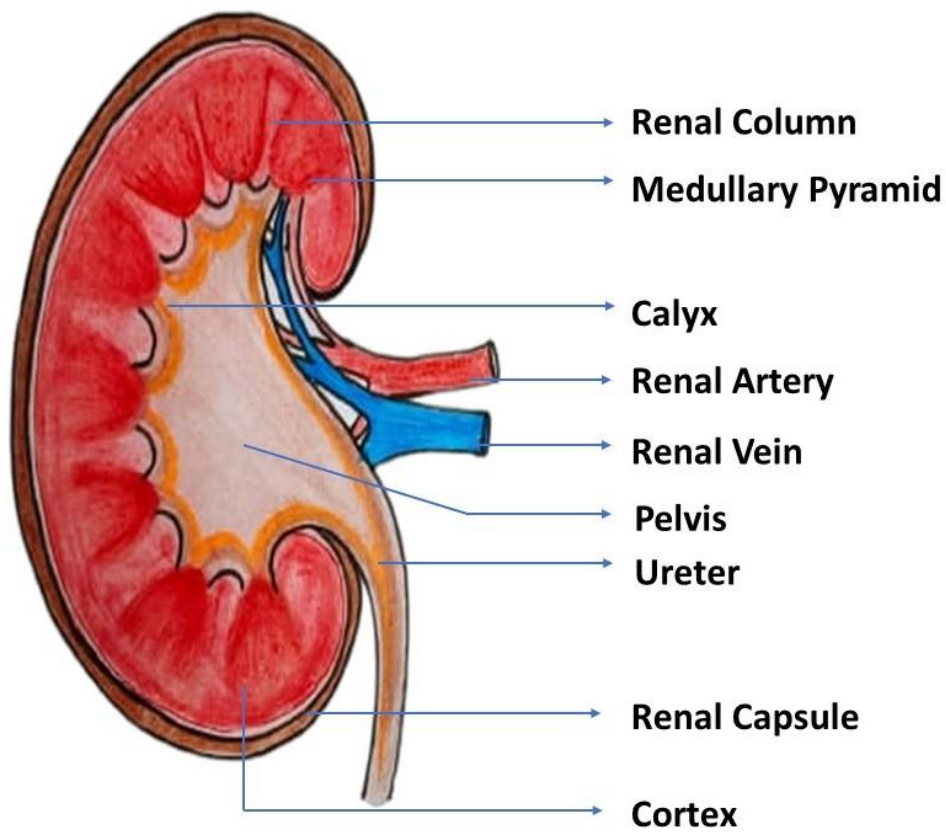


Figure 9. 1a: Structure of Kidney

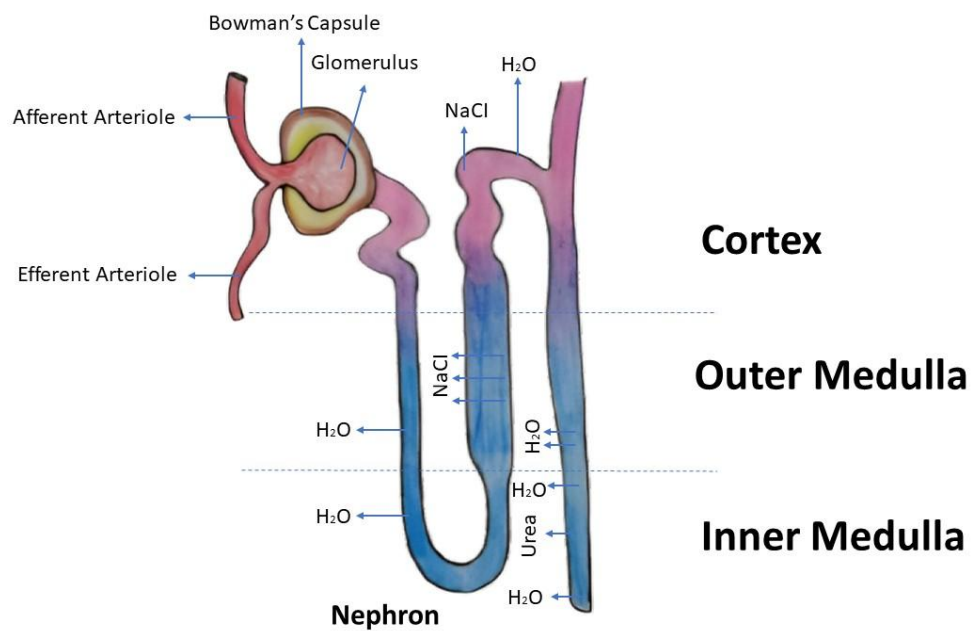


Figure 1 b: Structure of Nephron

10.3 FUNCTIONS OF KIDNEY

- The most important function of the kidney is to filter the blood for urine formation
- The kidney works as endocrine glands. It secretes enzymes renin, 1, 25-dihydroxycholecalciferol, erythropoietin etc.
- Regulation of red blood cell production through erythropoietin
- Regulation of blood pressure through renin enzyme
- Elimination of metabolic toxins, waste products, drugs and excess water through urine
- Acid base balance of blood by regulating pH balance (by reabsorbing bicarbonate from urine and excreting hydrogen ions and acid ions into the urine)
- Produce an active form of vitamin D3 (1, 25-dihydroxycholecalciferol) which is important for absorption of calcium and hence promotes strong and healthy bones
- Regulation of electrolytes and minerals
- Regulate osmotic pressure (osmoregulation) in the body by maintaining fluids and electrolyte balance
- Selective reabsorption of glucose, amino acids, fluid, bicarbonates, and electrolytes in the renal tubules

10.4 KIDNEY FAILURE

Renal failure is the inability of the kidneys to excrete the daily load of wastes. The failing kidney also loses the ability to handle excessive amount of fluids.

Chronic kidney disease (CKD) is kidney damage for ≥ 3 months as defined by structural or functional abnormalities of the kidney, with or without decreased GFR or $\text{GFR} \leq 60 \text{ ml/min/1.73m}^2$ with or without kidney damage for ≥ 3 months. CKD is classified based on the cause, GFR category (G1–G5), and albuminuria category (A1–A3), abbreviated as CGA

Risk factors for kidney disease:

- Diabetes mellitus
- Hypertension
- Family history of kidney failure (inherited diseases such as ADPKD)
- Old age
- Childhood kidney disease
- History of taking pain killers for long duration including non steroidal anti-inflammatory drugs (NSAIDs).
- Abnormal kidney structure
- Glomerulonephritis or pyelonephritis
- Deformities at birth that occur as a fetus develops;
- Lupus and other immune illnesses
- Obstructions such as kidney stones, prostatomegaly

- Recurrent urinary tract infections

10. 4. 1 SYMPTOMS

Many people may not have any severe symptoms until their kidney disease is much progressive in nature. Kidney disease may cause a wide array of symptoms. The most common symptoms are:

Anorexia (loss of poor appetite), nausea, vomiting, progressive weakness and early fatigue, altered palate sensation, food repugnance, taste alterations, dysgeusia (feeling of metallic taste) dryness of mouth trouble concentrating, trouble sleeping nocturnal muscle cramping, restless legs, poor concentration, pedal edema (swollen feet and ankles), facial puffiness. Puffiness around eyes, especially in the morning, impaired gastric emptying, impaired intestinal motility, haematuria (blood in urine), frothy urine, pruritus (itchy dry skin), and polyuria especially at night, decreased urine output, weight loss (loss of muscle mass, wasting) and hypoproteinaemia (hypoalbuminaemia)

Sometimes few nutritional deficits may also be noticed in these patients like angular stomatitis, cheilosis, rickets, osteomalacia, anaemia and pale coloured nails etc.

10. 4. 2 DIAGNOSIS OF KIDNEY DISEASES

Laboratory tests are essential for the diagnosis of CKD.

Blood test: Kidney function tests like haemoglobin, urea, creatinine, sodium potassium, total protein, albumin, Globulin, calcium, phosphorus, PTH, uric acid, chloride, alkaline phosphatase

Urine examination: Urine analysis for clarity, colour, microscopic examination, pH, specific gravity, osmolality and presence of abnormal constituents like blood protein etc.

Urine electrolytes: Like sodium, potassium, magnesium especially in tubular diseases, where additional loss may occur.

Imaging tests: Imaging tests allow viewing at the kidneys and the surrounding areas to identify anomalies or blockages. Common imaging tests may include kidney ultrasonography (USG), CT scans, urogram and MRI to get a clear image of the kidneys and urinary tract to assess the size and shape of the kidney to identify kidney or urinary tract structural abnormalities. CT scans are not a common choice in view of nephrotoxic dyes used in performing the test.

Kidney Biopsy: It is performed in some cases to check for a specific type of kidney disease or for more precise diagnosis of kidney disease.

Glomerular Filtration Rate (GFR): This shows how well a person's kidney is filtering waste products and it is used for assessing the stages of kidney disease.

Stages of CKD: GFR is comprehensively accepted as the measure of renal function. The CKD stage is defined by the level of GFR value. The lower GFR denotes the higher stages of CKD. The national kidney foundation (NKF) divided CKD into five stages depending on GFR values calculated using the CG (Cockcroft – Gault) equation. The renal replacement therapy (RRT) is required when GFR falls below 15 (stage 5) or end stage renal disease (ESRD).

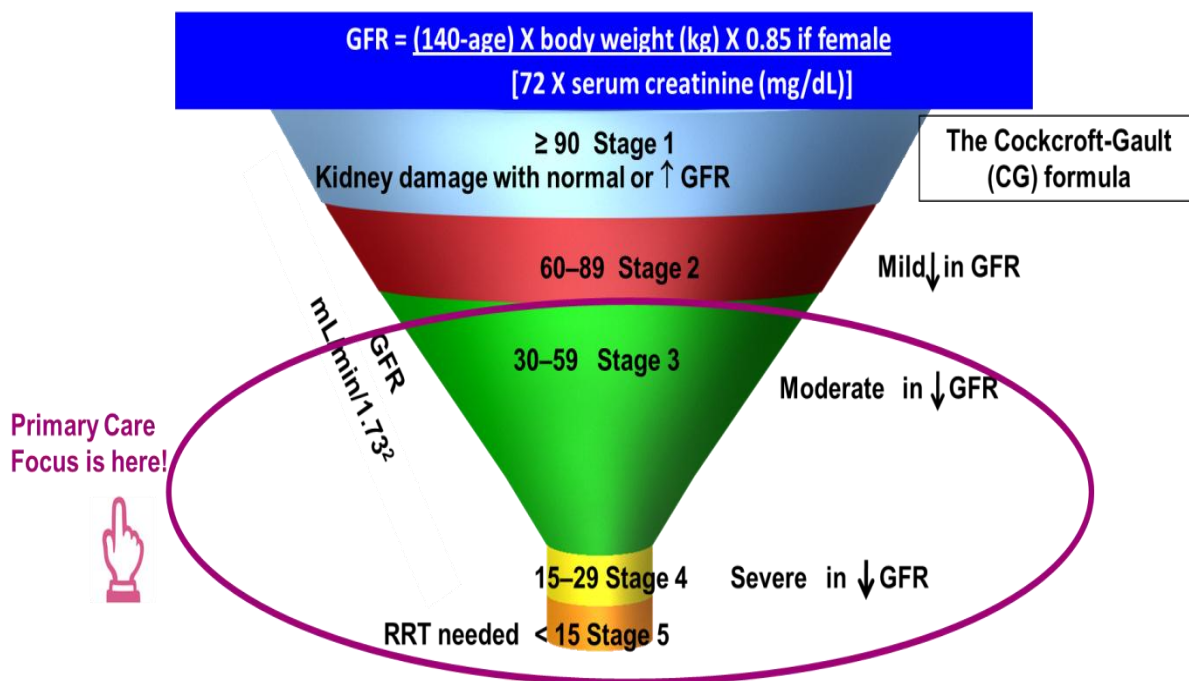


Fig 2: Partially adopted from Coresh et al: JAMA Nov 7, 07; 298(17): 2038-2047.

The 2012 KDIGO CKD classification recommends details about the cause of the CKD and classifies it into 6 categories based on glomerular filtration rate (G1 to G5 with G3 split into 3a and 3b). It also includes the staging based on three levels of albuminuria (A1, A2, and A3), with each stage of CKD being sub-categorized according to the urinary albumin-creatinine ratio in (mg/gm) or (mg/mmol) in an early morning “spot” urine sample.

As per the latest classification of CKD the 6 categories of CKD include:

- G1: GFR 90 ml/min per 1.73 m² and above
- G2: GFR 60 to 89 ml/min per 1.73 m²
- G3a: GFR 45 to 59 ml/min per 1.73 m²
- G3b: GFR 30 to 44 ml/min per 1.73 m²
- G4: GFR 15 to 29 ml/min per 1.73 m²
- G5: GFR less than 15 ml/min per 1.73 m² or treatment by dialysis

The three levels of albuminuria include an albumin-creatinine ratio (ACR)

- A1: ACR less than 30 mg/gm (less than 3.4 mg/mmol)
- A2: ACR 30 to 299 mg/gm (3.4 to 34 mg/mmol)
- A3: ACR greater than 300 mg/gm (greater than 34 mg/mmol).

This CKD classification has been advantageous in recognising prognostic indications linked to reduce renal function and augmented albuminuria. Though the disadvantage of this classification is potential overdiagnosis of CKD in the elderly population

Protein energy wasting most probably starts at stage 3 CKD or even before partly because of insufficient and inadequate dietary management during the pre-dialysis period and it becomes clinically obvious and noticeable when the GFR falls below 15-10 ml/min. The end stage renal disease (ESRD) patients are often develop a variety of metabolic and nutritional anomalies and majority of

them show signs and symptoms of PEW .

10. 4. 3 DEFINITION OF PEM/PEW

International Society of Renal Nutrition and Metabolism (ISRNM) defined protein energy wasting as the state of reduced body stores of protein and energy fuels. Malnutrition is considered to be a foremost reason of morbidity and mortality in CKD patients.

Prevalence of malnutrition: Various studies and data using standard measures of nutritional assessment have reported that a prevalence rate of approximately 18–75% in CKD patients on maintenance dialysis. Prevention, diagnosis and treatment of uremic malnutrition necessitate well-timed and suitable nutritional intervention. It is recommended and crucial to assess, evaluate and monitor the nutritional status of patients as an on-going process

Causes of malnutrition: The etiology of malnutrition in CKD patients is multifactorial. Malnutrition may be a result of uremic condition or may be associated with various comorbidities present. It may also be due to insufficient dietary intake owing to anorexia, nausea or vomiting. Dialysis, inadequacy, gastroparesis especially in diabetic patients etc may contribute to the pre-existing malnutrition. Dialysate losses of proteins and amino acids or abdominal distension due to glucose absorption (in case of peritoneal dialysis) may be responsible for malnutrition.

Methods for malnutrition assessment: Screening and assessment of nutritional status is of paramount importance for improving overall clinical outcomes in renal failure patients. It should be assessed with amalgamation of valid, complementary methods as compared to any single method only. A single measure is not sufficient enough to give a complete assessment of protein-energy malnutrition.

The Nutrition K/DOQI proposed a panel of the nutritional index that should be used in these patients

S. No.	Category	Measure	Minimum Frequency of Measurement
I.	Measurements that should be performed routinely in all patients	Predialysis or stabilized serum albumin	Monthly
		% of usual post hemodialysis (HD) or post-drain (PD) body weight	Monthly
		% of standard (NHANES II) body weight	Every 4 months
		Subjective Global Assessment (SGA)	Every 6 months
		Dietary interview and/ or diary	Every 6 months
		nPNA	Monthly MHD; every 3-4 months CPD

II.	Measures that can be useful to confirm or extend the data obtained from the measures in Category I	Predialysis or stabilized serum prealbumin	As needed
		Skinfold thickness	As needed
		Mid-arm muscle area, circumference, or diameter	As needed
		Dual energy x-ray absorptiometry	As needed
III.	Clinically useful measures, which, if low, might suggest the need for a more rigorous examination of protein-energy nutritional status	Predialysis or stabilized serum - Creatinine - Urea nitrogen - Cholesterol - Creatinine index	As needed As needed As needed

(Adapted from KDOQI, 2000)

Early detection of kidney diseases is important for prevention of malnutrition and improving the clinical outcomes and QOL in CKD patients. Dietary management is very important and considered as cornerstone in the clinical management of these patients.

10. 4. 4 GOAL OF DIETARY MANAGEMENT IN KIDNEY DISEASES

The dietary goal should be to slow down the progression of kidney disease, improve or prevent protein energy malnutrition / wasting and also to prevent / treat comorbidities (if present) like diabetes, hypertension, dyslipidaemia and cardiovascular disease, anaemia, metabolic acidosis, secondary hyperparathyroidism. A good meal plan with appropriate dietary choices can also minimize build-up of waste products and fluid between the dialysis treatments, improve nutritional and functional status, preserve muscle mass / lean body mass, maintain electrolyte balance. The emphasis should not only be to augment the nutritional needs and also to improve the quality of diet consumed.

Assessment of dietary intake in kidney diseases: The energy and protein intake in adults with CKD 3-5D should be assessed properly. The K/DOQI guidelines suggest 3-day diet recall as a preferred method to assess energy and protein intake conducted on both the dialysis as well as the non-dialysis days. However, 24-hour dietary recall, food frequency questionnaires, and PCR might also be used as an alternative method for assessing dietary intake in renal failure patients. Symptoms of anorexia, nausea, vomiting, dietary habits and dietary pattern, frequency and timing of the meals eaten, quantity and quality of food ingested and fluid balance should be properly and carefully evaluated and compared with that of the recommended intake so that the nutritional gap can be filled through individual dietary counselling by an expert and skilled dietician.

Body weight estimates are used to estimate the dietary needs of kidney patients as the standard reference norms in chronic kidney disease patients are lacking. The guidelines suggest that clinical judgment should be used to decide the method for measuring body weight [eg, whether to use the actual measured weight or history of weight changes (whether patient has gained weight, lost weight or

there is no change in the body weight) or sequential weight measurements. Post dialysis weight should be used in maintenance hemodialysis and post drain weight should be used in peritoneal dialysis patients to calculate the nutritional requirement. Adjusted edema free body weight (BW_{ef}) should be used for the patients who have an edema free body weight <95% or > 115% of the median standard weight, as determined from NHANES II data.

$$(aBW_{ef}) = BW_{ef} + [(SBW - BW_{ef}) \times 0.25]$$

BW_{ef} actual edema free body weight SBW standard body weight

One has to be careful and able to distinguish between dry weight changes versus fluid shifts. The dry weight should be calculated carefully to accurately calculate the nutritional needs of these patients.

Energy Intake: Adequate amount of energy is needed daily to spare protein and to prevent malnutrition and wasting in kidney patients. The recommended calorie intake is 35 kcal/kg/day for patients less than 60 years of age and 30-35 kcal/kg/day for patients aged more than 60 years. Restriction of total energy intake is recommended for overweight or obese patients or if the patient is more than 65 years and who is likely to have a sedentary lifestyle. The KDOQI guidelines 2020 recommend 25-35 kcal/kg of energy intake for metabolically stable CKD patients from stage 1-5D (1C) based on age, gender, level of physical activity level, body composition, goals of weight gain or loss, stages of CKD, and presence of comorbidities or inflammation in order to maintain nutritional status.

Dietary protein Intake: Several studies have documented that majority of Indian patients are vegetarian and consume much less protein than that recommended by the NIN and ICMR. The concern is not only the quantity of dietary protein but also the quality of dietary protein consumed. Protein restrictions should not be customarily advised without estimating the total dietary protein intake in these patients. Providing sufficient calorie in the diet is essential for protein sparing action. When quantity of protein in the diet is limited, emphasis should be on improving the quality of protein consumed.

Dietary Protein intake for non-dialyzed patients with CKD stages IV and V: KDOQI guidelines suggest that for CKD patients with GFR less than 25 ml/min and not undergoing any dialysis modality, a well-planned low protein diet comprising of a protein intake of 0.6 g/kg/day should be used. However, a dietary protein intake of 0.75 g/kg/day may be suggested for those patients who will not be able to accept such diet and not able to maintain adequate dietary energy intake. A dietary protein intake of 0.6-0.8 g/kg/day may be prescribed for diabetic CKD patients on conservative management and not on dialysis to optimize glycemia as well as to maintain nutritional status.

Type of dietary proteins: The previous guidelines mainly emphasize on the fact that consumption of fifty percent of the total dietary protein intake should be from high biological value protein.

There is inadequate evidence and data to recommend a particular protein type considering their impact on the nutritional status, or their effect on the lipid profile, serum calcium or phosphate levels in these patients. Based on this fact, the newer KDOQI 2020 guidelines suggest that total calorie and protein intake should be met depending on the preference of the patients for animal or plant protein. The diet of these patients should also supply sufficient amount of essential amino acids in the diet. A judicious combination of vegetarian diets with animal food items like egg whites, low fat milk, milk products and lean meat will be able to meet all the required macro and micronutrient.

Meeting protein needs: The total dietary protein intake should be estimated before making any dietary modifications in these patients. The vegetarian patients may be allowed to continue to eat their

regular diet without over restricting their usual protein intake if it is within the recommended dietary allowances. Similarly diet of the patients eating non-veg foods frequently should also be assessed and necessary modifications may be made accordingly. Consumption of non-veg foods can be continued by replacing the other protein source in that particular meal with the non-veg food in frequency and quantity advised by dietician while making a balance of other nutrients and minerals. Self-made restrictions and any food myths contributing to pre-existing malnutrition should also be assessed and rectified.

Protein requirement in dialysis patients: Protein requirement increases in patients undergoing dialysis treatment. There are losses of protein during dialysis. Around 1 to 3 g per hemodialysis session and 5-15 g/day in peritoneal dialysis. The protein losses increase during the episodes of peritonitis in case the patient on peritoneal dialysis.

The latest KDOQI guidelines recommend prescribing 1.0-1.2 g/kg /day protein for maintaining the nutritional status in non-diabetic and diabetic metabolically stable CKD patients on maintenance haemodialysis or peritoneal dialysis. Higher dietary protein intake may be required for patients who are at the risk of developing hyperglycaemia and/or hypoglycaemia in order to maintain euglycaemia.

Improving the quality of vegetarian protein: vegetarian proteins are considered as incomplete protein or low biological value protein because they are lacking in one or more amino acids. Various sources of vegetarian proteins should be selected and combined with each other judiciously. The relative insufficiency of a particular amino acid (AA) of any vegetarian food can be overcome by thoughtful combination with other vegetarian food items having adequate level of that limiting AA. Moreover, the nutritive value of a mixture of two proteins will be higher than arithmetic average of the individual values by improving the quality of vegetarian proteins.

The quality of rice protein (defined in terms of biological value, digestibility coefficient, net protein utilization and protein efficiency ratio) seems to be better than wheat protein. Moreover, the quantity of protein is low in rice compared to wheat so rice should be included in the diet of CKD patients. Amount of rice may be exchanged wisely with other sources of carbohydrate (like wheat chapatti) adjusting the total amount of carbohydrate in diabetic CKD patients to maintain blood glucose level.

Dietary carbohydrates: Diet of CKD patients should include sufficient amount of carbohydrate to meet the energy requirement for prevention of starvation, ketosis and for reducing protein catabolism (protein sparing effect).

Dietary carbohydrate intake in diabetic CKD patients: The quantity, quality as well as timing of carbohydrate consumed are significant in diabetic CKD patients as it is the major determinant of postprandial glucose excursion in these patients. The amount of carbohydrate should be kept fairly constant for every meal for patients taking the fixed dose of insulin or on oral hypoglycemic agents so that insulin dose can be adjusted around constant carbohydrate intake rather than carbohydrate being changed to meet insulin schedule. Patients must be encouraged to consume meals at regular time. Two-hour postprandial blood glucose levels should be monitored in the patients having normal premeal blood glucose levels but have deranged HbA1c.

For proper management of blood glucose level in diabetic CKD patients, nutrition education and training should be imparted to them on regular basis regarding carbohydrate counting, food exchange list, experience-based estimation of portion sizes, reading food labels, use of food pyramid, healthy food plate, measuring cups and spoons or suitable food scale to help them choose right quantity and quality of food. Educating them regarding use of glycemic index and glycemic load may provide additional benefit for glycemic control.

Dietary fat Intake: CKD patients are likely to have atherogenic lipoprotein profile once renal function starts decreasing. As per NKF-KDOQI guidelines the dietary approach to dyslipidaemia in

CKD patients should be the similar to persons without renal failure. The American Heart Association recommends that the total fat should be 20-30 % of total energy intake, PUFA should be less than 10 %, SFA should not be more than 7 – 10 % and intake of trans fats should be less than 1% of total energy intake. The dietary cholesterol intake should be 200-300 mg per day. Modification may be done depending on the weight, metabolic profile, current dietary intake and individualized treatment goals.

A judicious combination of cereals, pulses, vegetables, low fat milk and milk products and variety of vegetable oils helps in maintaining a desirable P/S fats ratio (~0.8-1.0) and it is cardio protective also. Moreover, fat from varied sources is always better than any single type of oil to provide optimal essential fatty acid but moderation is the key.

Dietary Potassium Intake: Causes of hyperkalemia (high serum potassium level in the blood) need to be identified and rectified after taking detailed dietary history from patients and reviewing the medicine prescription. Possible causes could be excessive intake of potassium rich foods, chronic constipation, Infection, GI bleeding, hyperglycemia, metabolic acidosis, drug nutrient interactions, decreased urinary output, chewing tobacco, use of salt substitute and use of ACEi /ARBs.

40-70 mEq of dietary potassium may be used for CKD stages IV and V: The ADA 2020 recommends less than 60 mEq/day of potassium for hyperkalemia. After taking a diet recall identify the high potassium foods and offer suitable alternatives containing low potassium try to make diet achievable and palatable.

In case of hyperkalaemia, low potassium fruits and vegetables should be advised and limit the foods with high potassium content. Leaching of pulses and vegetables should not be routinely advised in all patients. It should be done only in patients with hyperkalemia (high serum potassium level). Salt substitute should be avoided.

The latest guidelines recommend limiting the dietary sodium intake to less than 100 mmol/day or less than 2.3 g/day of sodium to decrease blood pressure and improve volume control as well as to decrease proteinuria to sustain desirable body weight in patients with CKD stage 3 to 5D.

The important point to keep in mind is that serum sodium is not always a trustworthy marker of dietary sodium intake in renal failure patients with volume overload as it can dilute an elevated level (dilutional hyponatremia) so the serum sodium levels must be evaluated in concurrence with fluid status in these patients.

Salt Intake: The salt intake should be restricted in these patients and foods high in dietary sources of sodium should be avoided.

Practical aspects of reducing salt in the diet: The patients should be educated and encouraged to reduce the amount of salt used in cooking and preparation of meals, steadily over a period of few weeks so that the taste buds get adapted. Meals should be prepared from fresh ingredients adding only a recommended amount of salt but none afterwards or prepare the foods without salt and add prescribed quantity later on. Limit or avoid foods rich in sodium like achar, papad, chutney, sauces, salted nuts and salted butter, ready to eat meals/ processed food /canned food/junk and fast foods / meals prepared with Mono Sodium Glutamate.

Maintaining the palatability of the food: The dietary intake should not be compromised by over restriction of the salt and dietary sodium. To make low salt diet palatable spices /herbs and condiments like ginger, garlic, onion, lemon, kokum/ tamarind /lemon/grated raw mangos and vinegar, cinnamon, cloves, nutmeg, cumin and black pepper (portion size matters after adjusting the potassium, sodium content). Emphasis should be placed on encouraging to read the food labels

Dietary Phosphorus Intake: Hypophosphatemia (high serum phosphorus level) is common and

constant challenge in the clinical management of CKD patients. K/DOQI 2020 guidelines recommend that dietary phosphorus intake should be adjusted to maintain normal serum phosphate levels in patients with renal failure. Individualized and Intensive dietary counselling should be done for proper, adequate nutritional knowledge and awareness of various dietary sources and their bioavailability.

Food sources and bioavailability of phosphorus: Both animal and plant protein sources contain organic phosphorus. Approximately 40 – 60 % of organic phosphorus is absorbed. Bioavailability of phosphorus is better in animal food items (~70 %) as compared to phosphorus bioavailability from plant-foods (less than 50%) because of the presence of phytates which is not readily and easily bioavailable.

Foods sources comprising certain beverages like colas, snack bars, frozen meals, processed or spreadable cheeses, enhanced meats, instant food items, and frozen bakery products are rich in inorganic phosphorus which are readily bioavailable (> 90 % Inorganic phosphorus is being absorbed). Bioavailability of phosphorus from a typical mixed diet is 55-70 %.

The benefit of low bioavailability (low intestinal absorption) of phosphorus from plant-based food items should not be overlooked when preparing a diet chart restricted in phosphorus but adequate in protein for dialysis patients for controlling hypophosphatemia.

Phosphorus from the food additives is almost completely bioavailable for absorption by the body which imposes additional phosphorus burden. The patients must be educated and encouraged to search for the word “phos” on ingredient lists for hidden phosphorus content.

Phosphorus to protein ratio: The K/DOQI guidelines recommend the use of phosphorus to protein ratios for proper control of dietary phosphorus. These composition tables are also beneficial for limiting the intake of high phosphorus foods without compromising intake of adequate amount of dietary proteins. Limiting the non-protein sources of phosphorus seems like better strategy and is more effective in the prevention or improvement of malnutrition. Egg white has lowest phosphorus to protein ratio of 1.46 : 1. It should be included in the diet. Besides being lowest in phosphorus to protein ratio it is the reference protein also.

Controlling hyperphosphatemia: As GFR decreases, level of phosphorus increases in the blood and this elevated level of serum phosphorus stimulates the release of PTH that releases calcium from bone causing the bones to become weaker and may cause renal osteodystrophy. Therapeutic approaches directing phosphorus control consist of restriction of dietary phosphorus, reducing intestinal absorption of phosphorus by using appropriate phosphate binders with meals, and removing phosphorus with adequate dialysis. Fortunately, simple methods including soaking foods in water and boiling them helps in significant reduction of dietary phosphorus content per gram of protein in foodstuff. Source of readily absorbed phosphorus should be discouraged like beverages containing phosphoric acid (e. g. regular and diet cola's), beer and chocolate. Unfortunately phosphorus clearance by dialysis (MHD and PD) is also poor. This necessitates the demand for phosphorus binders to prevent phosphorus from being absorbed in the gut; form insoluble compound is excreted in stool. Food sources high in phosphorus can be taken at the time of consumption of phosphate binders prescribed.

Reading Food labels: Apart from looking for the macronutrients only the patients with CKD should be educated for developing a habit of reading food labels which help them to look for the amount of sodium, potassium and phosphorus in foods. Encourage them to check the ingredient list for potassium as sometimes sodium chloride (salt) is replaced in some foods with potassium chloride. Ingredient list must also be checked and must be evaluated for **phosphorus**, or **for words with PHOS for identifying the** hidden phosphorus as food additives. All these tips and tricks may help to

control hyperphosphatemia.

Fluid Intake: Fluid balance is one of the very important aspects in the nutritional and clinical management of CKD and dialysis patients. Thumb rule for fluid prescription is previous day 24-hour urine output + 500 ml, if patient is dry and 24-hour urine output + 300 ml if patient is edematous. However, Fluid requirement varies significantly from patients to patients depending on many factors. It has to be personalised depending on IDWG, blood pressure, residual renal functions and fluid restrictions may need to be increased in case there is increased IDWG or presence of CHF, edema etc

Prevention of fluid overload: Detailed physical examination is needed for assessing the extent of fluid overload. An extensive detail history from the patient with renal failure regarding urine output, fluid intake, ultrafiltration (in case of dialysis) compliance with dialysis exchanges [if on peritoneal dialysis (PD)] and pattern of weight gain for patients on maintenance dialysis (MHD) is a pre requisite. MHD patients must be regularly assessed for IDWG and PD patient must be reviewed regularly for weight change, urine output, ultrafiltration achieved with each PD exchange and solution toxicity (1. 5 %, 2. 5 % or 4. 25 %) after reviewing the patient's PD record book. Modifications in their fluid intake may be done accordingly.

Patients on dialysis gain several kg of fluid between HD treatments. Fluid gain of more than 5%, may reveal excessive fluid intake leading to hypertension, edema, ascites, pleural effusion, breathlessness. Fluid gains of less than 2% indicates minimal fluid and food intake, patients may be losing body mass. Limiting the IDWG to 2-5 % estimated dry weight is a good strategy.

Ways to limit fluid intake: Patients must be educated to avoid salty and fried foods to decrease thirst. Instead of milk patients are suggested to use paneer or hung curd, to have thick dal or thick gravies to save the fluid allowances. Small cup or glass can be used. Fluid allowances must be spread evenly throughout the day. Medications may be taken with the meal-time liquids and not with extra water. Candy, peppermint or flavoured ice cubes can be used to quench the thirst.

Conclusions: Nutrition is of paramount importance at every stage of CKD for the prevention of malnutrition. All the misconceptions and myths relate to diet and food has to be corrected and clear among the patients. Individualized and patient centric realistic meal plan and dietary counselling initiating at early stages of CKD and also at commencement of dialysis with regular follow-up on-going basis with diet diaries help to prevent malnutrition in CKD patients. Holistic dietary approach rather than specific nutrient restriction is crucial. All the macro- and micro nutrients deficiencies have to be identified before they become clinically evident and prevent PEW from setting in.

10.5 RENAL CALCULI

Renal calculi or urinary calculi disease or kidney stone disease, also known as renal stone disease or nephrolithiasis is now become a public health concern. When the concentration of ions and solutes (like H⁺, Na⁺ and uric acid) are present in more than normal (supersaturation) amounts, kidney stones (crystalline structures) may be formed. Presence of crystallized calcium, magnesium, cysteine, or uric acid in the renal system may give rise to renal stones. The prevalence and incidence of kidney stones is rising at an alarming rate in developing countries like India. Serious discomfort may be seen as the size of renal calculi increases due to course of time, ignorance or untreated conditions which may cause substantial damage and may lead to renal injury.

10.5.1 SYMPTOMS

Many patients with renal calculi may remain asymptomatic. The most common symptoms associated with renal calculi are unilateral flank pain due to acute ureteral obstruction. Haematuria is commonly

observed in renal calculi.

10. 5. 2 ETIOLOGY OF RENAL CALCULI

Reason for stone formation is multi-factorial. Various risk factors may include demographic and lifestyle factors, faulty dietary habits, age, race / ethnicity, consumption of salt and fluid, obesity, insulin resistance, dehydration, presence of various co-morbidities, physical inactivity, temperature, heredities, metabolic conditions (metabolic diseases such as diabetes, metabolic syndrome, hypertension, hyperuricemia), dairy products and fast / junk food and use of various medications may be concomitant with renal calculi. Moreover, the dietary consumption of sodium, oxalate, citrate, uric acid, calcium-rich foods, protein, as well as fluids intake considered as part of the dietary characteristics linked with stones inhibition or formation.

10. 5. 3 NUTRITIONAL MANAGEMENT OF RENAL CALCULI

Understanding the associated risk factors is of utmost importance. Various dietary factors play a vital role in the risk of the developing renal calculi. Suitable dietary modifications along with pharmacological intervention for rectification of various risk factors help in the prevention of recurrent stone formation. Understanding simple dietary alterations may significantly reduce the risk of renal stones. Tailormade dietary recommendations based on metabolic evaluation aids in the renal calculi prevention. Simple dietary amendments including low salt intake, reducing tea intake, lowering junk foods consumption play a noteworthy role in renal calculi prevention.

Oxalates: Oxalates come from food and through the indigenous production in liver. Food sources include chocolate, nuts, tea [green/black], spinach, soya protein. Dietary modifications help in managing the intake.

Dietary treatment of calcium oxalate stones includes reducing or removing intake of dietary oxalate. Restricting cocoa drinks, chocolate, candies, black tea, excessive coffee intake, spinach, rhubarb, asparagus, celery, parsley and tomatoes. Calcium oxalate stone formers should limit intake of almonds, peanuts, cashews, walnuts, beetroot, sapota, cocoa, chocolate, tomato, strawberries, eggplant, soy products, tofu, wheat bran and rice bran.

Water: Adequate fluid intake is one of the most important dietary approaches to prevent stone formation. Limited fluid intake and dehydration may also contribute to renal calculi formation. Low urine production may cause supersaturation of calcium, oxalate, urate, and phosphate, which may contribute to renal stones. Increasing fluid intake leads to dilution of urine and reducing the acids concentration and decreasing the supersaturation of calcium oxalates. The various guidelines approve keeping optimal fluid intake distributed throughout the day. Appropriate hydration decreases the chances of urinary tract infections and further decreasing risk for struvite stones.

Protein: A dietary protein intake of 0.8 g/kg of body weight equivalent to the RDA is considered as safe intake. Adult patients with calcium oxalate stones should limit the daily intake of animal proteins.

Sodium: The increased consumption of sodium increases the excretion of calcium. High sodium intake increases the urinary calcium, reducing urinary citrate and promoting the induction of urate-induced calcium oxalate crystallization. In adults, the sodium intake should not exceed 2 g/day (5 g of salt/d).

Potassium: Restriction of dietary sources of potassium may enhance calcium excretion. Hypokalaemia reduces the urinary excretion of citrate, an important inhibitor of calcium oxalate formation. Increase consumption of potassium-rich foodstuffs like vegetables and fruits signifies an alkali load which upsurges urinary citrate excretion.

Calcium: It is advocated to keep the calcium intake of up to 1000 to 1200 mg/day. Supplementation with calcium may decrease bioavailability of intestinal oxalate and its absorption, lessens urinary oxalate excretion leading to hypercalciuria. Calcium intake should remain within the RDA of 800–1,000 mg/day. Calcium supplements taken between meals may increase the risk of stones and calcium consumed with meals has the reverse result decreasing the hazard of calculi.

Hyperuricemia: The hyperuricemia is associated with renal calculi. Foods rich in purines are derived mostly from animal protein sources may be linked with high risk of calculi, while purine-rich plant foods are not associated to stones formation, and dairy products present reduced stones formation risk, decreasing the consumption of meat, chicken and seafood which will decrease the intake of purine and, therefore, production of uric acid increases. Higher intake of fruits and vegetables should raise urinary pH and reduce the risk of uric acid crystal formation,

Cysteine: Patients with cysteine stones should restrict sodium intake and increase fruit and vegetable intake. Reducing animal protein will be beneficial in increasing urinary pH. Restriction of methionine-containing foods like peanuts, pistachio, popcorns, broccoli, mushroom, cauliflower, avocado, bean sprouts, potatoes, spinach, green peas, tofu, kidney beans, black beans and tempeh may prevent cysteine crystal formation.

Renal calculi and dietary pattern: Dairy and vegetable foods seem to have an anti-calculi effect. The vegetarian diet has been shown to have a protective effect against kidney stone formation especially when it contains lots of seasonal vegetables and fruits, whole grains, legumes, moderate protein (0.8 g/kg/day), only little amount of animal protein, low fat milk and milk products in balanced amount, low in salt, sodium and uric acid. Adequate hydration is a pre requisite. Diet pattern analogous to the classic dietary approaches to stop hypertension (DASH) diet and the Mediterranean diet helps in renal calculi prevention. These diets are typically limited in sodium, adequate in potassium, calcium, and magnesium, and seem to have anti-calculi effects.

Diet plan: The individualized diet plan for patients with renal calculi should be planned depending on patients' routine, their dietary habits, socio-economic status, individual metabolic profile, type of stone (stone composition), biochemical profile, dietary intake food preferences and accessibility to various food items and modifications can be made accordingly. Adequate hydration is a must.

Regular physical activity: Regular physical activity should be done to maintain ideal body weight or to reduce weight if overweight or obese.

10.6 NEPHROTIC SYNDROME

It is a clinical condition or renal impairment which leads to the excretion of protein in the urine. Protein loss of more than 3–3.5 g/day customarily signposts the nephrotic syndrome. It may happen because of damage to glomerular basement membrane leading to an upsurge of glomerular permeability and subsequent loss of albumin and other plasma proteins in the urine more than normal level.

In other words, nephrotic syndrome may be defined as a medical scenario with an amalgamation of proteinuria, hyperlipidemia, hypoalbuminemia and edema.

NS is demarcated by the presence of:

- Proteinuria (urine protein excretion of either 3+ or 4+ on a urine dipstick test or a spot protein/creatinine ratio of more than 2 mg/mg, or urine albumin level of more than 40 mg/m² per h)
- Serum albumin of less than 2.5 g/dL
- Edema

- Dyslipidaemia with serum cholesterol level more than 200 mg/dl

Nephrotic syndrome may be primary disease being unambiguous to the kidneys or may be secondary as a renal manifestation of a systemic disease.

10. 6. 1 SYMPTOMS OF NEPHROTIC SYNDROME

Though the synthesis of albumin in the liver upsurges but still not sufficient enough to recompense for the urinary albumin losses leading to edema. This lower level of serum albumin actuates the hepatic synthesis of lipoprotein and cholesterol with subsequent hyperlipidemia. Simultaneously, breakdown of serum lipoproteins is decreased in the liver and excretion of HDL is augmented in the urine. Moreover, certain medicines (steroids, diuretics, and antihypertensive drugs) every so often used in the treatment of nephrotic syndrome may further aggravate the pre-existing dyslipidaemia.

The common symptoms may include edema especially near eyes and in ankles and legs, frothy urine and weight gain owing to volume overload. Sometimes ascites or pleural effusions may be present.

10. 6. 2 DIETARY GOAL IN NEPHROTIC SYNDROME

Reducing and controlling the proteinuria is the primary goal of treatment. The overall dietary goal is to lessen the associated symptoms (edema and increased lipid level in the blood), compensate the albumin losses, spare dietary proteins, decline the rate of progressive renal impairment and atherosclerosis, control hypertension (if present) through a well-planned timely, adequate and appropriated individualized dietary management. Patient centric practical dietary tips with respect to dietary management are important.

Dietary Management

Very high protein intensifies proteinuria and may accelerate related renal disease. Moderate dietary protein restriction not only decreases urinary protein losses but also reserves serum albumin concentration. Moreover, modest protein restriction 0.8 g/kg/day have been shown to maintain nitrogen balance.

Weight monitoring: dry weight should be estimated especially if edema or /and ascites is present. Growth and development have to be monitored and recorded routinely in children.

Energy intake in adults: Adequate energy intake is recommended, at least 30 - 35 kcal/ kg /day in adults. Calorie restriction may be needed in overweight or obese patients. Adequate amount of calories is needed to achieve and maintain ideal body weight and maintain protein stores (protein sparing). Foods rich in complex carbohydrates should provide the majority of energy.

Energy intake in Children: In children the energy should be based on the estimated average requirement for children of the same chronological age. In simplest words the energy requirement should meet at least RDA for the normal children of same height age. Calorie intake in the diet should be sufficient enough to enhance the efficiency of protein (for protein sparing effect) and avert the children from landing into catabolic state. Height age should be used for energy estimation when use of chronological age does not account for the growth,

Protein According to the Indian Paediatric Nephrology Group (IPNG), a well-balanced diet, adequate in protein (1.5–2 g/kg) and calories, is recommended. Patients with persistent proteinuria should receive a dietary protein intake of 2–2.5 g/kg/day. In adults the recommendation for dietary protein intake is 0.8 g/kg/day is recommended. Dietary restriction reduces urinary elimination of proteins, decreases protein breakdown and oxidation of amino acids and hence maintains nitrogen balance. Each gram of urinary protein loss should be replaced by addition one gram of high biological value protein in the diet.

A dietary protein intake of 1.2 g/kg/day is recommended to avoid hazards of growth retardation. Protein is needed for achieving positive nitrogen balance and for growth in malnourished and protein depleted children.

FAT: The diet plan should include low cholesterol (<200 mg), low saturated fat (<7-10%) rich in PUFA for these patients. As per Indian Paediatric Nephrology Group (IPNG) total dietary fat should not exceed more than 30% of the total daily calories. The focus should be on maintenance of desirable body weight or loss of surplus weight if overweight or obese to decrease the jeopardy of cardiovascular disease.

Children taking steroids: steroid dependent children with frequent relapse may need long standing nutritional counselling as well as assessment and monitoring of nutritional status for maintenance of weight, prevention of malnutrition. Prednisolone indeed increases the appetite and hunger pangs and dietary advice regarding the prevention of obesity is vital especially for obese children and adolescents. Unhealthy food stuffs like biscuits, chips, cookies, chocolates cold drinks, french fries, pastries, patties, bakery products, burgers, pizza, and doughnuts should be avoided. Healthy eating habits should be inculcated and reinforced repeatedly at subsequent follow up with reports and diet diary.

Potassium: No modification is routinely needed for potassium, but potassium losses due to diuretics may require supplementation. In case of high serum potassium (if present), dietary adjustment has to be done accordingly.

Salt, Sodium and Fluid: Management of salt, sodium and fluid is essential for controlling edema and hypertension (if present). Patients must be educated regarding the practical approaches, tips and tricks for restricting the fluid. Majority of steroid-sensitive nephrotic syndrome patients may not require salt restriction but restriction of salt intake is recommended for patient having persistent edema. Sodium restriction of 1-g/day is generally required for controlling edema and hypertension. A well strategic meal plan low in dietary sodium or salt aid to prevent or reduce fluid restriction. Food items high in dietary sodium have to be limited or avoided. The salt and fluid restriction are generally needed only until the patient is having a remission. Afterward the liberal fluid intake is allowed and salt intake should be restricted only if there is associated hypertension.

Hypertension: Optimal lifestyle modification along with salt restriction and avoiding prolonged prednisolone therapy are adequate treatment in most of the cases.

Supplements: Patients with nephrotic syndrome commonly show deficiency of vitamin B and Zinc and may get benefit from supplement. Children with low level of serum calcium and vitamin D intake may be associated with the risk of low bone mass. The children on steroid therapy should be supplemented with calcium and vitamin D.

Monitoring: All the patients with nephrotic syndrome having recurrent relapse, steroid-dependent or steroid-resistant nephrotic syndrome necessitate assessment and monitoring of nutritional status. At risk or malnourished patient may require detailed anthropometry, clinical examination and biochemical evaluations in order to detect hostile effects of drugs. It is also vital to calculate the GFR. It is crucial that patients must be tracked up in subsequent visit for nutritional evaluation at regular follow up visit with diet diaries for checking the dietary compliance level and dietary modification as per requirement. Diet should not be too restrictive unnecessarily. Try to make the diet plan achievable and practical which they can follow easily,

10.7 GLOMERULONEPHRITIS

Glomerulonephritis is a cluster of diseases that damage the glomeruli filtering the blood. Acute and chronic glomerulonephritis are the two important types of glomerulonephritis. The acute

glomerulonephritis develops precipitously.

10. 7. 1 SYMPTOMS OF ACUTE GLOMERULONEPHRITIS

The initial symptoms of the acute glomerulonephritis may include facial puffiness mainly in the morning, presence of blood in the urine or brown coloured urine, micturiting less frequently. The etiology of acute illness may be due to infections such as strep throat or may be caused by other ailments comprising of lupus, Wegener's disease, good pasture's syndrome and polyarteritis nodosa. For prevention of kidney failure, it is crucial to diagnose early and treat promptly for improving various clinical outcomes.

10. 7. 2 SYMPTOMS OF CHRONIC GLOMERULONEPHRITIS

The chronic glomerulonephritis may develop silently over a period time and often leads to renal failure. Initial signs and symptoms of the chronic glomerulonephritis may include proteinuria, hematuria, hypertension, frothy urine, facial puffiness and swelling around the eyes and edema of ankles legs or hands and frequent nocturnal micturition.

Healthy diet and optimal lifestyle modifications are vital for maintain health and to decrease the risk of developing ailments affecting kidneys. Dietary goals are to maintain ideal body weight, prevent malnutrition and wasting, slow down the progression of disease and reliving or decreasing the associated symptoms, maintaining normal blood pressure and normal blood sugar levels in diabetics. Adequate calories with moderate protein, low salt and sodium potassium and phosphorus with individualized fluid prescription.

All the causes of glomerular disease may not be preventable. However, it is essential to find out the treatable causes of illness as soon as possible treat early to sluggish the renal injury and helps to prevent it from getting worse.

10. 7. 3 DIETARY GOAL IN GLOMERULONEPHRITIS

Controlling Protein Intake:

Glomerulonephritis often impairs kidney function, reducing the ability to filter waste products effectively. A key dietary goal is to control protein intake to minimize the production of nitrogenous waste. The amount of protein should be tailored based on the severity of kidney impairment. High biological value proteins, such as eggs, lean meat, fish, and milk, are recommended in moderate amounts to meet essential amino acid requirements without overburdening the kidneys.

Sodium Restriction:

Sodium restriction is crucial to manage edema and hypertension, which are common symptoms of glomerulonephritis. A low-sodium diet (typically 1,500–2,000 mg/day) helps control fluid retention and blood pressure. Processed and packaged foods, which are high in sodium, should be avoided, and fresh foods should be preferred. Cooking with herbs and spices instead of salt can enhance flavor while keeping sodium intake low.

Managing Fluid Intake:

Fluid management depends on the patient's urine output and the level of fluid retention. In cases of significant edema or reduced urine production, fluid intake may need to be restricted. The fluid allowance is often calculated based on the previous day's urine output plus 500–700 ml to account for insensible losses.

Potassium Regulation:

Potassium levels need careful monitoring in glomerulonephritis, especially if hyperkalemia (high potassium levels) develops due to reduced kidney function. Foods rich in potassium, such as

bananas, oranges, potatoes, and tomatoes, may need to be limited if potassium levels are high. On the other hand, if hypokalemia (low potassium levels) is a concern, potassium intake may need to be increased.

Maintaining Energy Levels:

Adequate caloric intake is necessary to meet energy requirements and prevent the breakdown of body protein stores for energy. Energy can be derived from carbohydrates and fats, with a focus on complex carbohydrates, such as whole grains, fruits, vegetables, and healthy fats, such as those from nuts, seeds, and oils like olive or canola.

Phosphorus and Calcium Balance:

Patients with glomerulonephritis may develop hyperphosphatemia due to impaired kidney function. This can lead to bone disorders if not managed. Foods high in phosphorus, such as dairy products, nuts, and processed foods with phosphate additives, may need to be restricted. Calcium supplements or foods fortified with calcium may be recommended to prevent bone loss, but these should be managed under medical supervision.

Reducing Inflammation:

Anti-inflammatory dietary components, such as omega-3 fatty acids found in fatty fish (salmon, mackerel) and flaxseeds, may help reduce inflammation associated with glomerulonephritis. Including a variety of colorful fruits and vegetables rich in antioxidants can further support immune health and reduce oxidative stress.

Individualized Nutritional Plan:

Each patient's dietary goals must be tailored based on the type and severity of glomerulonephritis, associated symptoms, lab results, and any other medical conditions. Regular follow-up with a healthcare provider, including a nephrologist and a dietitian, is essential to monitor nutritional status and adjust the diet plan as needed.

10.8 LET US SUM UP

The kidneys are vital organs responsible for filtering waste, maintaining fluid and electrolyte balance, and regulating blood pressure. Kidney-related conditions, such as kidney failure, renal calculi, nephrotic syndrome, and glomerulonephritis, significantly impact these functions and present with symptoms like swelling, fatigue, changes in urine output, and pain. Protein-Energy Malnutrition (PEM/PEW) is common in kidney diseases, emphasizing the need for dietary management tailored to the condition. Nutritional goals focus on reducing the kidneys' workload, controlling sodium, protein, and fluid intake, ensuring adequate caloric and nutrient balance, and preventing further complications. A comprehensive understanding of these conditions highlights the critical role of diet in both prevention and management, ensuring better health outcomes and quality of life for affected individuals.

10.9 CHECK YOUR PROGRESS

Short Questions

1. What are the primary functions of the kidney?
2. Define glomerulonephritis in brief?
3. Name two common symptoms of nephrosis?
4. List any two types of urinary calculi?

5. What is the main dietary restriction in renal failure?

Long Questions

1. Explain the structure and functions of the renal system and how they are affected in renal diseases.
2. Discuss the etiology, symptoms, and dietary management of acute and chronic glomerulonephritis.
3. Describe the dietary recommendations for patients with nephrosis.
4. Analyze the prevention, types, and dietary management of urinary calculi.
5. Elaborate on the stages of renal failure and the role of nutrition in managing the condition.

UNIT-11 : NUTRITION IN GASTRO INTESTINAL DISTURBANCES

- 11.1 Introduction
- 11.2 Structure of Gastrointestinal System
- 11.3 Functions of Digestive System
- 11.4 Gastro Intestinal Enzymes
- 11.5 Disease Specific Nutritional Dietary Management
- 11.6 Diarrhoea
 - 11.6. 1 Etiology of Diarrhoea
 - 11. 6. 2 Symptom of Diarrhoea
 - 11. 6. 3 Diagnosis of Diarrhoea
 - 11. 6. 4 Prevention of Diarrhoea
- 11. 7 Constipation
 - 11. 7. 1 Symptom of Constipation
 - 11. 7. 2 Etiology of Constipation
 - 11. 7. 3 treatment and dietary management Of Constipation
- 11. 8 Peptic Ulcer
 - 11. 8. 1 Symptom of Peptic Ulcer
 - 11. 8. 2 Types of Peptic Ulcer
 - 11. 8. 3 etiology of Peptic Ulcer
 - 11. 8. 4 Diagnosis of Peptic Ulcer
 - 11. 8. 5 treatment and dietary management of Peptic Ulcer
- 11. 9 Flatulence
 - 11. 9. 1 Symptom of Flatulence
 - 11. 9. 2 Etiology of Flatulence
 - 11. 9. 3 Treatment and dietary management of Flatulence
- 11. 10 Let Us Sum Up
- 11. 11 Check Your Progress

11. 1 INTRODUCTION

The gastrointestinal (GI) tract is a critical system in the human body, responsible for the digestion and absorption of nutrients, maintenance of immune function, and protection against pathogens. Disturbances in the GI system, such as gastritis, peptic ulcers, irritable bowel syndrome (IBS), inflammatory bowel disease (IBD), celiac disease, and malabsorption syndromes, can disrupt these functions, leading to significant nutritional deficiencies and overall health complications. These disorders often result in symptoms like nausea, diarrhea, constipation, bloating, and pain, which can interfere with food intake, nutrient assimilation, and overall well-being. Nutrition plays an integral role in the prevention, management, and treatment of gastrointestinal disturbances. Tailored dietary modifications can alleviate symptoms, support the healing of the GI mucosa, and prevent malnutrition. For example, low-fiber diets are often recommended during acute inflammation, while

probiotics and prebiotics can enhance gut health in certain conditions. This chapter examines the intricate relationship between nutrition and GI health, highlighting dietary strategies and therapeutic interventions aimed at restoring gut function, managing symptoms, and enhancing the quality of life for individuals with gastrointestinal disturbances.

11. 2 STRUCTURE OF GASTROINTESTINAL SYSTEM

The structural gastrointestinal system consists of the gastrointestinal (GI) tract along with accessory organs. The gastrointestinal tract consists of the buccal cavity, larynx, pharynx, oesophagus, stomach, duodenum, small intestine, large intestine, and anal canal. The accessory or supporting organs include teeth, tongue, and glands such as salivary glands, liver, gallbladder, and pancreas. The major functions of the gastrointestinal tract include food ingestion and digestion, essential nutrient absorption, secretion of wastes from body in form of extra water and enzymes, excretion of waste products.

The upperpart of GI tract is oesophagus, the tube that connects mouth and stomach. The food goes through the oesophagus to get stored in the stomach. Stomach can hold up to a quart and a half of food and stomach cells has elastic property that can extend up to a big bag. Figure 1 shows the GI system with its accessory organs.

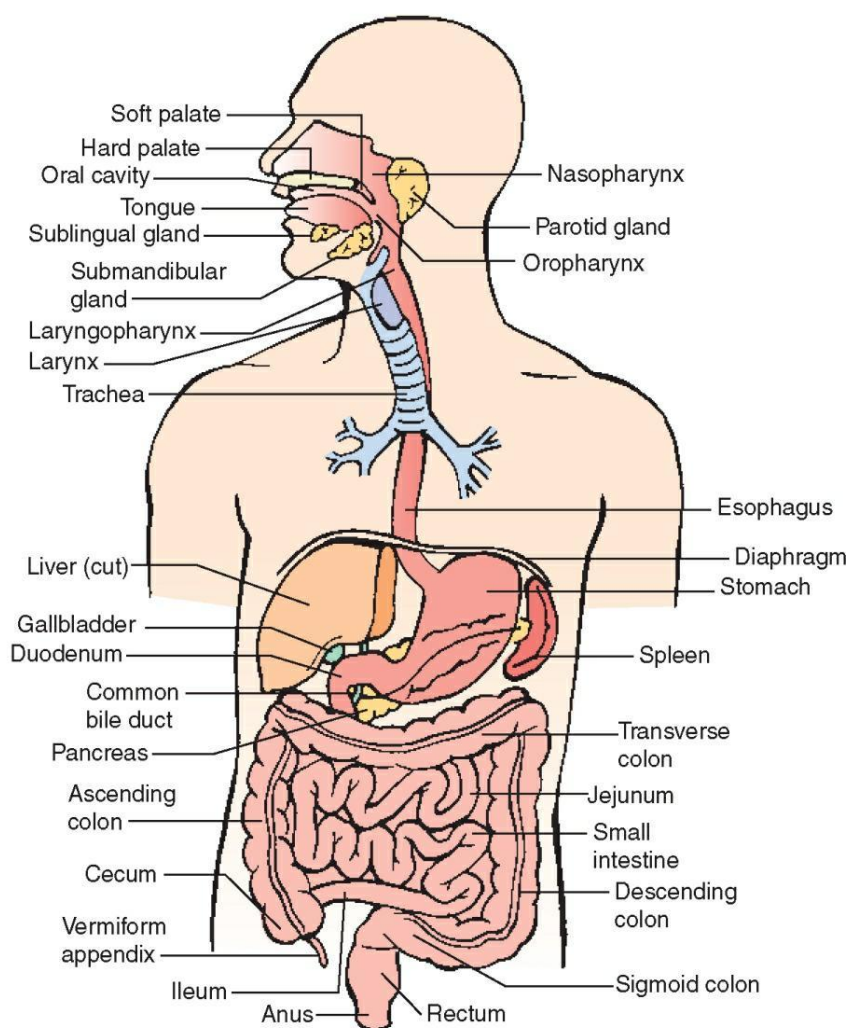


Figure 1: The Gastrointestinal system. Image source: SARAH Wayt- Anatomy and physiology- The Gastrointestinal system, July 23, 2023

11.3 FUNCTIONS OF DIGESTIVE SYSTEM

This uniquely designed system provides constant nutrients which provide energy, building blocks and other essential nutrients to every cell of the body. These essential nutrients are achieved by breaking down food which leaving organisms, eat into small enough particles to pass into the cell membrane, known as digestion and the transformation of the small particles to the circulatory system to be carried in different parts the body, known as absorption.

Every organ in GI system plays a specific role.

The Buccal Cavity: Buccal cavity consists of lips, teeth, lining inside the cheeks, tongue, salivary glands, upper and lower palate which anatomically perform different aspects that work collectively, effectively and efficiently several functions. Oral cavity or buccal mucosa is lined by keratinized epithelium which consists of superior surface of the tongue and hard palate and other nonkeratinized squamous epithelial cells consists of lips, cheeks and inferior surface of tongue, none of them are known to aid in absorption, except for mucosa inferior to tongue. The actions performed in buccal cavity are mastication, which is chewing on food to physically break it into small chunks. This process is also referred to as mechanical digestion during mastication and chewing.

Here the first most function is sensory evaluation of the food which we eat then before swallowing and mechanical processing with help of the teeth, tongue, the palate surfaces. Buccal cavity helps in lubrication by allowing food to mix with salivary glands secretions, mucus which perform limited breakdown of carbohydrates and lipids in mouth.

Functions of the tongue: Tongue mechanically process the food by compression, distortion abrasion and manipulation to help in chewing, preparing food material for swallowing. Tongue has very unique function of sensory analysis of touch, temperature feeling and taste receptors, then secretion of enzymes like mucins and lingual lipase. lingual lipase has broad pH that breaks down lipids (triglycerides).

Buccal cavity, has three 3 of salivary glands:

1. **Parotid salivary glands:** located inferior next to the zygomatic arch and posterolateral to the mandible. Parotid glands produce a large amount of salivary amylase which breaks down carbohydrate into simpler forms.
2. **Sublingual salivary glands:** these are located on the floor of mouth. The sublingual glands produce a secretion that is both a buffer and lubricant.
3. **Submandibular salivary glands:** are located on the floor of mouth within mandibular groove. They secrete a mixture of buffers, glycoproteins which is known as mucins, and salivary amylase.

Oesophagus: After the food being swallowed, peristalsis movement pushes the food down via oesophagus into stomach.

Stomach: The stomach is meant to store, churn, makes pureed food into a substance known as chyme. Gastric juices are secreted by cells of the stomach, contributing to chemical digestion. Muscles of stomach mix the food with the digestive juices secreted by stomach.

Pancreas: Pancreas makes three kinds of digestive enzymes known as lipase, protease, and amylase that break down carbohydrates, fats and proteins. The beta cells of the islets of Langerhans that secrete hormone insulin. The pancreas disposes these enzymes and hormone into the small intestine via duodenum through tubes called ducts.

Liver: The largest gland or organ in the human body is liver which performs more than 500 functions

in body. Liver makes a digestive juice called bile that helps in digestion fats and some vitamins. The bile ducts carry bile from liver to gallbladder for extra storage, and to small intestine for further use.

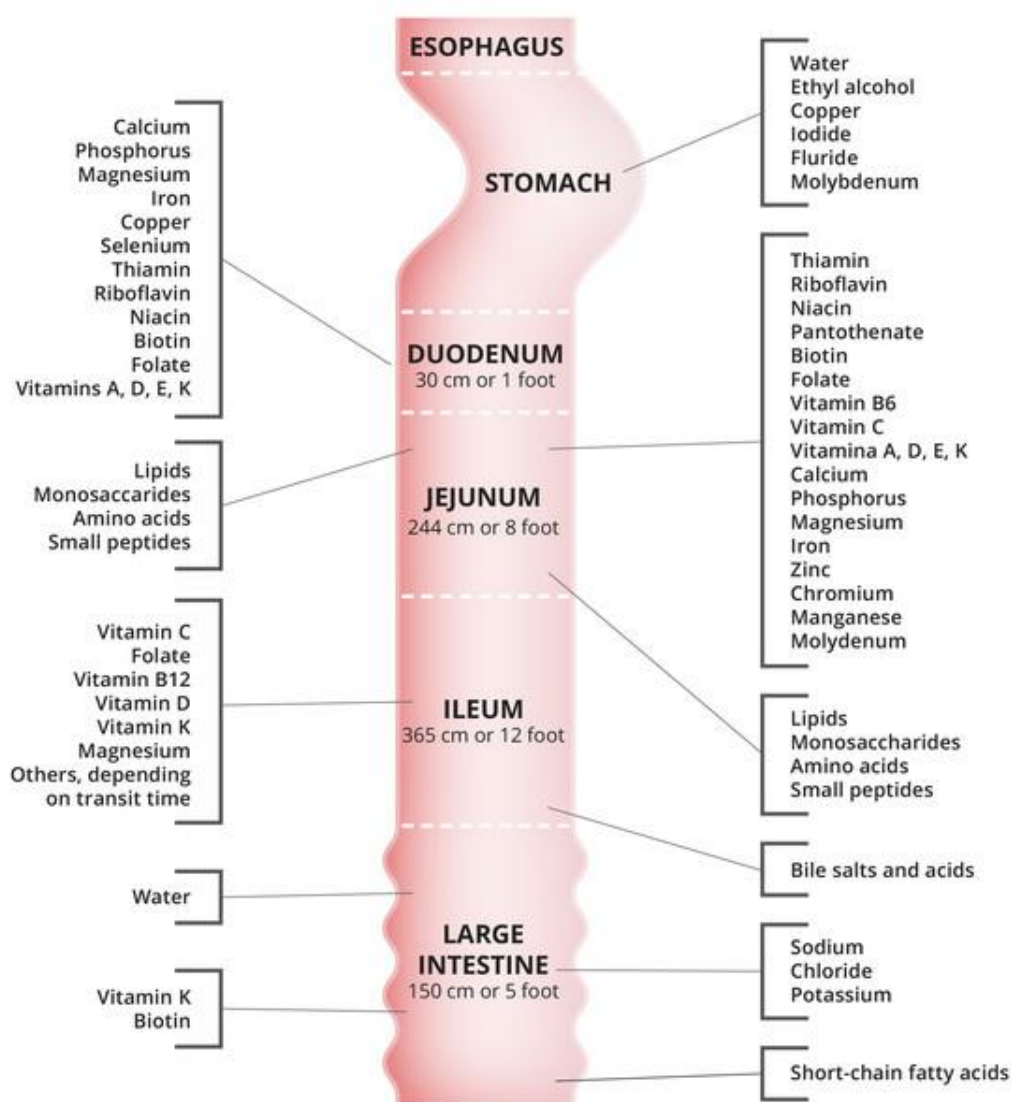
Gallbladder: Gallbladder stores extra bile between meals while eating, gallbladder squeezes bile via bile duct into small intestine for action on food.

Small intestine: The small intestine consists of pylorus (stomach) to the ileocecal valve (ileum). Small intestine is composed of duodenum, jejunum, and ileum.

Duodenum: Average length of duodenum is 30 cm or 1 foot. Acts on by mixing chyme with bile, secretes bicarbonates to increase pH so that to activate pancreatic enzymes which digest the chyme.

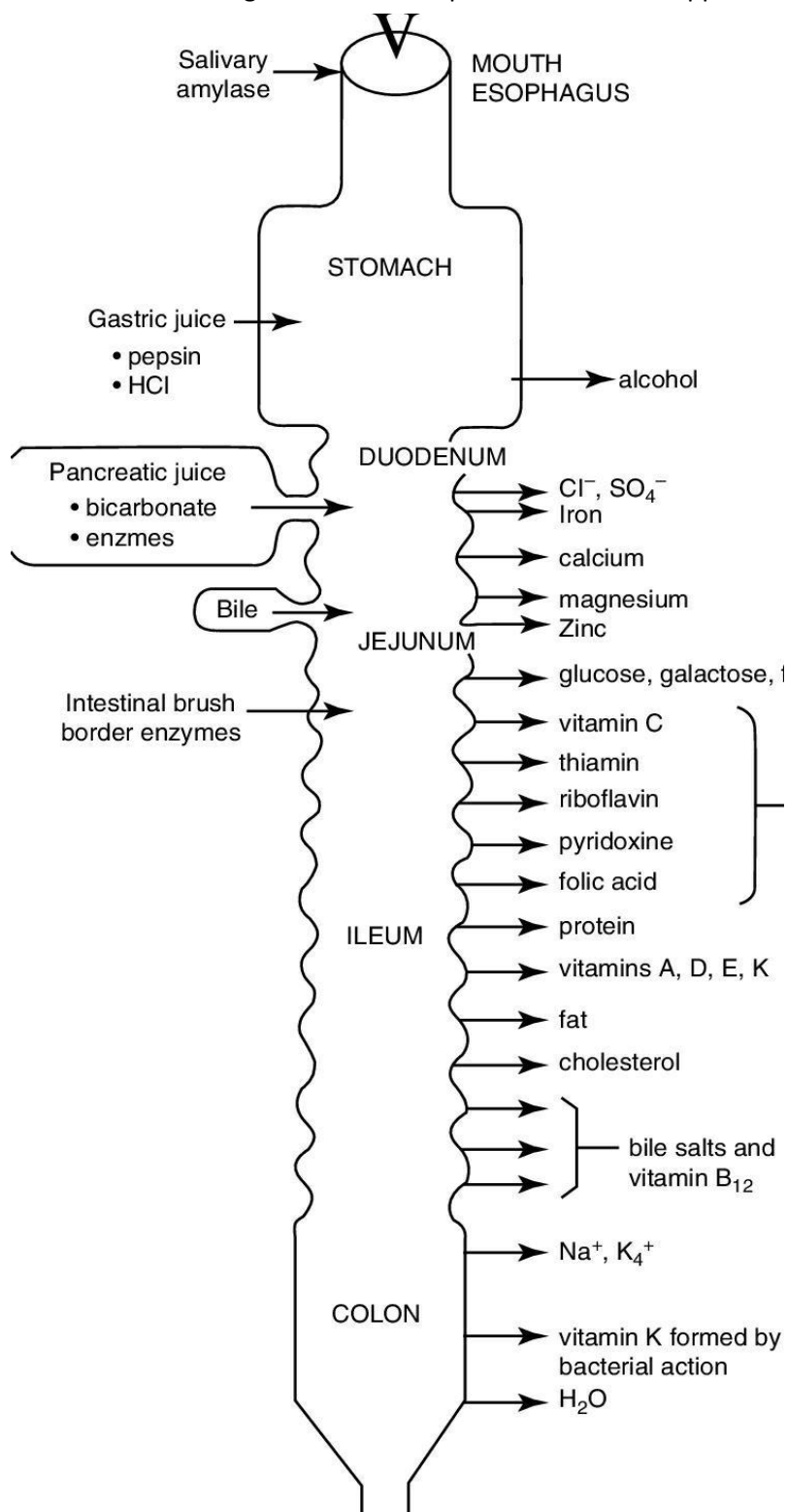
Jejunum: In an adult Jejunum measures 244cm or 8 feet in length. Jejunum absorbs lipids, small peptides, glucose and other small nutrients that have been previously digested in duodenum.

Ileum: Approximate size of ileum is 365 cm to 12 feet absorbs vitamin D, K, C and B12, bile salts and all necessary nutrients that were not absorbed in jejunum



Note: The duodenum, jejunum and ileum make up the small intestine.

Cecum: A pouch that divides small and large intestine connects ileum with ascending colon. Small intestine also produces digestive juice that mixes with bile and pancreatic juice to work and to complete the breakdown of protein, carbohydrate, fat and lipids. Small intestine makes some of the enzymes needed to digest carbohydrates. Small intestine takes water from bloodstream into lower gastrointestinal tract to help digestion of food. It also absorbs water with other nutrients for body requirement. Primarily small intestine works as absorption of vitamins, nutrients, including electrolytes, carbohydrates, iron, proteins, fats and other micronutrients. Most of digestion and absorption of nutrients happens here.



Large intestine: In an adult human large intestine is 150cm /5feet. Like small intestine, large intestine also has several segments, according to its physiology, anatomy and functional capacity.

Ascending colon: Absorbs water from food and moves into the transverse colon by peristalsis movement.

Transverse colon: From hepatic flexure to splenic flexure; absorbs water, salts and electrolytes.

Descending colon: From splenic flexure to sigmoid colon; stores fecal feces.

Sigmoid colon: Due to the contraction pressure inside the colon, stool moves into the rectum.

In large intestine, more water gets absorbed and further utilised into the bloodstream. Bacteria in large intestine help break down remaining nutrients and make vitamin K. Waste products from action of digestion, absorption including bigger molecules of food that are still too large to get utilised become stool.

Rectum: – It holds the formed feces waiting to eliminate when feeling of defecation.

11. 4 GASTROINTESTINAL ENZYMES

Gastrointestinal enzymes are biological catalysts that facilitate the breakdown of food into simpler, absorbable molecules, enabling the body to obtain energy and essential nutrients. They are secreted by different organs, including the salivary glands, stomach, pancreas, and small intestine which play specific role in digesting carbohydrates, proteins and fats.

1. Salivary Enzymes

Digestion begins in the mouth, where saliva contains enzymes that start breaking down carbohydrates:

- **Amylase** (Ptyalin): This enzyme is secreted by the salivary glands and acts on starches, breaking them down into maltose (a disaccharide). Its activity is short-lived as it is deactivated in the acidic environment of the stomach.

2. Gastric Enzymes

The stomach secretes enzymes that initiate protein digestion and contribute slightly to fat digestion:

- **Pepsin:** Pepsinogen, an inactive precursor secreted by gastric glands, is activated by hydrochloric acid into pepsin. Pepsin breaks down proteins into smaller peptides. It functions optimally in the stomach's acidic environment (pH 1.5–2.5).
- **Lipase:** Gastric lipase helps digest a small amount of dietary fats, converting triglycerides into glycerol and free fatty acids. Its activity is limited compared to pancreatic lipase.
- **Rennin** (in infants): Found predominantly in infants, rennin helps coagulate milk proteins, making it easier to digest.

3. Pancreatic Enzymes

The pancreas is the primary source of digestive enzymes, secreted into the small intestine:

- **Amylase:**

Pancreatic amylase continues carbohydrate digestion by breaking down starches into maltose.

- **Lipase:**
This enzyme efficiently digests triglycerides into glycerol and free fatty acids, assisted by bile salts that emulsify fats to increase surface area for enzyme action.
- **Proteases:**
 - **Trypsin** and **Chymotrypsin:** Secreted as inactive forms (trypsinogen and chymotrypsinogen), these enzymes are activated in the small intestine. They cleave proteins into smaller peptides.
 - **Carboxypeptidase:** Breaks down peptides into individual amino acids by cleaving terminal amino acids.

4. Intestinal Enzymes

The small intestine produces enzymes that complete digestion, breaking down complex molecules into their simplest forms:

- **Disaccharidases:**
 - **Maltase:** Breaks down maltose into two glucose molecules.
 - **Lactase:** Converts lactose (milk sugar) into glucose and galactose. Lactase deficiency leads to lactose intolerance.
 - **Sucrase:** Splits sucrose into glucose and fructose.
- **Peptidases:**
These enzymes break small peptides into individual amino acids for absorption.
- **Enterokinase (also called Enteropeptidase):**
Activates trypsinogen into trypsin, which in turn activates other pancreatic proteases, ensuring efficient protein digestion.

Role in Digestion

1. **Carbohydrate** **Digestion:**
Begins in the mouth (salivary amylase), continues in the small intestine with pancreatic amylase, and is completed by intestinal disaccharidases like maltase, lactase, and sucrase.
2. **Protein** **Digestion:**
Initiated in the stomach (pepsin), it progresses in the small intestine with the action of pancreatic proteases (trypsin, chymotrypsin) and is completed by peptidases.
3. **Fat** **Digestion:**
Limited activity occurs in the stomach (gastric lipase), but most of fat digestion happens in the small intestine due to pancreatic lipase, aided by bile from the liver for fat emulsification.

Clinical Importance

Deficiencies or dysfunctions in GI enzymes can lead to malabsorption and related disorders:

- **Lactase deficiency:** Causes lactose intolerance, leading to bloating and diarrhea after consuming dairy.
- **Amylase deficiency:** Results in difficulty digesting starches.
- **Protease deficiencies:** Can lead to protein malabsorption, muscle wasting, and reduced

immunity.

- **Lipase deficiency:** Causes fat malabsorption, resulting in steatorrhea (fatty stools) and deficiencies of fat-soluble vitamins (A, D, E, and K).

11.5 DISEASE SPECIFIC NUTRITIONAL DIETARY MANAGEMENT

11. 6. DIARRHOEA

Feeling of defecation to eliminate wastes out of body is a normal GI function but when this urge changes and one has more frequent episodes of loose to watery stool, is called diarrhoea. This is common condition and usually resolves without intervention but when it lasts for more than 3-4 episodes for more than 3 days it needs medical attention. Diarrhoea can present alone or can be associated with other symptoms, like abdominal pain, discomfort, nausea, vomiting and cramps, loss of appetite and weight loss.

Diarrhoea is short-lived GI condition, lasting no more than a few days. When diarrhoea lasts beyond 2 or more days into weeks, this indicates it is because of another associated issue — like irritable bowel syndrome (IBS) or some more serious disorder, may be persistent infection, celiac disease / gluten enteropathy or inflammatory bowel disease (IBD) like ulcerative colitis or Crohn's disease.

The most serious risk caused by diarrhoea is dehydration. During a single episode of diarrhoea, water and electrolytes like sodium, chloride, potassium and bicarbonate are lost through watery stools, vomiting, fever, sweat, urination and breathing. Person suffering from diarrhoea can be severely dehydrated where losses are not replaced appropriately. In addition, diarrhoea is a major cause of malnutrition in children, pregnant women and elderly, this makes the person more susceptible in future bouts of diarrhoea and to other infectious diseases.

11. 6. 1 ETIOLOGY OF DIARRHOEA

Common cause of most self-limited diarrhoea is usually not known. The common cause of diarrhoea are:

1. Bacteria
2. Virus
3. Other Pathogens like parasitic infections

Indeed, diarrhoea is a common symptom of infections caused by a host of viral, bacterial and parasitic organisms, which are mostly spread by faeces-contaminated water, food and air. Infection can happen to them, when there is shortage of adequate sanitation, hygiene and safe water for drinking and cleaning.

Rotavirus (virus) and *Escherichia coli* (bacteria), are the two most common etiological agents for moderate-to-severe diarrhoea in low-income groups or in developed countries. Other pathogens which are responsible are **cryptosporidium** and **shigella** species in some reasons-specific etiological patterns also need to be considered.

Other possible causes of diarrhea: Infections by other organisms and pre-formed toxins

1. Foods that upset the digestive system (high osmotic fluids like sugar syrups, laxatives etc.)
2. Intolerances and allergies to certain foods (Lactose intolerance and celiac disease).
3. Medications. e.g. antibiotics
4. Radiation therapy

5. Other mechanical issues

11. 6. 2 SYMPTOM OF DIARRHOEA

Signs and symptoms of with diarrhea (loose to watery stools) may include -

- Bloating
- Abdominal cramps or pain
- Nausea
- Vomiting
- Fever
- Mucus in the stool
- Blood in the stool
- Low urine output
- Urgent need to have a bowel movement

11. 6. 3 DIAGNOSIS OF DIARRHOEA

When diarrhea lasts for more than 4 days or still symptoms persist such as fever or bloody stools, physician may need to find the cause. Gastroenterologist/physician may take information from medical and family history, physical examination, blood tests and stool tests (if diarrhea lasts for more than 2 weeks) to find the cause of diarrhea.

Diagnostic tools are –

- Complete blood count test,
- Measurement of electrolytes
- Kidney function tests can help indicate the severity of your diarrhea
- Stool test (clinician might recommend stool test to check if a bacterium or parasites are causing diarrhea)
- Whole abdomen ultrasound
- Hydrogen breathe test etc.

11. 6. 4 PREVENTION OF DIARRHOEA

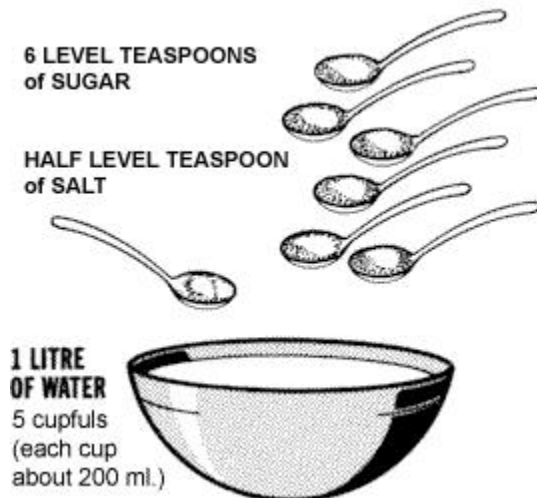
Diarrhoea is often caused by infection. Chances of diarrhoea can be stopped or reduce risk by ensuring high standards of hygiene.

1. Washing hands thoroughly with soap and warm water after going to the toilet and before eating or preparing food.
2. Cleaning toilets, toilet handle and the seat, with help of disinfectant after each episode of diarrhoea.
3. Don't share towels, cutlery, utensils, food, with other members.
4. Avoid potentially unsafe water sources and uncooked food when travelling abroad.

Oral rehydration solution formula recommended by World Health Organization (WHO) contains-

ORS - millimoles per liter, the following: sodium- 90, Chloride- 80, potassium, glucose- 111 and a base is like as citrate tribasic or bicarbonate-30.

If the diarrhoea happens to infants and children, breast feeding need to be continued for maintaining hydration and by giving plain water.



11. 7 CONSTIPATION

Constipation is a clinical condition in which one may have less than three bowel movements in a week, stools which are hard, dry, and lumpy which are difficult or painful to pass; or a feeling of incomplete evacuation (that not all stool has been passed). Usually, constipation can be prevented by lifestyle and dietary changes.

Types of constipation: There are three main types of functional constipation.

1. **Normal-transit constipation-** Most common type of constipation and is caused by dysfunction of muscles and nerves that are responsible for bowel movements.
2. **Slow-transit constipation** - Caused by the way food moves through the intestines to the colon nerves aren't properly signaling colon muscles to move the way they should do.
3. **Pelvic floor dysfunction** - When the muscles involved in anus and rectum are too weak or too tight to allow the regular bowel movements.

11. 7. 1 SYMPTOM OF CONSTIPATION

The definition of constipation itself says about the classic symptoms of chronic constipation which are less than three bowel movements a week.

1. Hard, dry or lumpy stools
2. Stools are difficult or painful to pass
3. Feeling of incomplete evacuation that all stool has not passed.
4. Other symptoms are
 - bleeding from your rectum
 - blood in your stool
 - constant abdominal pain
 - inability in passing gas

- distended abdomen
- loss of appetite
- vomiting
- lower back pain
- losing weight

11. 7. 2 ETIOLOGY OF CONSTIPATION

Constipation can appear when life or daily routine changes. For example, bowel habits can change

- Change in over all dietary habits
- Reduced intake of dietary fibre
- Reduced fluids intake
- Less physical activity
- High intake of simple and refined carbohydrate
- Pregnancy
- Old age
- Travelling
- Ignoring the urge for a bowel movement
- Medicines

Certain other associated health and nutrition problems can cause constipation:

- Sedentary lifestyle
- Dehydration
- Celiac disease
- Brain and spine disorders, such as Parkinson's disease
- Brain or spinal cord injuries
- Metabolic diseases, such as diabetes
- Hormonal imbalance, such as hypothyroidism
- Inflammatory diseases or proctitis, intestinal obstructions, anorectal blockage, tumors etc.

11. 7. 3 TREATMENT AND DIETARY MANAGEMENT OF CONSTIPATION

Increasing enough dietary fibre and drink plenty of liquids to help fiber work better.

Fiber: Depending on age and sex, adults should get 25-30 grams of fiber per day or per 1000 kcal diet, 14gms of fiber is recommended to avoid constipation.

Make sure to add fiber in diet a little at a time so body gets used to the change and can digest well without any problem like bloating, distension etc.

Sources of fiber: Whole grains and products, whole pulses and legumes, fresh fruits and berries, fruits with skin specially apple, pears and orange, vegetables, broccoli, green peas, green leafy vegetables, grains like roasted gram, corn, beans etc

- legumes such as lentils, kidney beans, soybeans and chickpeas as whole.

- Fruits - berries, apples with the skin, oranges, pears etc.
- Vegetables - carrots, broccoli, green peas, and collard greens, green leafy vegetables etc.
- nuts, such as almonds, peanuts, and pecans, others food and products such as whole-grain breads and cereals, dried fruits, wheat bran, wheat germ, fresh fruits and vegetables including the skin on potatoes, dried beans and peas, oats, barley, brown rice last but not least plenty of water.

Drinking water and other liquids throughout a day such as fresh fruit and vegetable juices and clear soups, so that the fiber work better. This change will make stool soft and easy to pass.

Drinking plenty of water and other liquids is also a good idea to avoid dehydration. Maintaining hydration is good for overall health and can help avoid getting constipated.

11.8 PEPTIC ULCER

What are peptic ulcers: Peptic ulcer is a type of sore that develops on the inner lining of the stomach or duodenum and the upper part of the small intestine just below the stomach. In some cases, peptic ulcer may develop just above stomach, in esophagus.

11.8.1 SYMPTOMS OF PEPTIC ULCER

Anyone can develop a peptic ulcer, and the most common symptom is burning sensation, abdominal pain, loss of appetite and indigestion. Peptic ulcer symptoms may vary in person to person depending upon the cause. The excess acid production can lead to varying symptoms such as diarrhoea, abdominal pain, acid reflux, nausea, vomiting, and decreased appetite.

The typical abdominal pain can occur anywhere from navel up to your breastbone, and may follow any of these patterns as symptoms -

1. Feels worse when stomach is empty
2. Feels better temporarily while eating or take an antacid
3. Gets worse at night in lying down position
4. Comes and goes for days or weeks

Peptic ulcers may be caused by a bacterial infection, certain drugs, or rare tumors.

11.8.2 TYPES OF PEPTIC ULCER

The common kinds of peptic ulcers are based on the location where they occur and affect organ part.

1. Esophageal Ulcers: These occur inside the esophagus, the tube that carries food from throat to stomach.

2. Gastric Ulcers: Most common type of ulcer, occur inside the stomach.

3. Duodenal Ulcers: This type of ulcer is located in the upper part of the small intestine, called the duodenum.

11.8.3 ETIOLOGY OF PEPTIC ULCER

It was thought that spicy foods or stress can cause peptic ulcers which gets worse after consuming spicy and oily food but the exact reason responsible for this condition is unknown.

In fact, the most common causes of ulcers are:

- Use of nonsteroidal anti-inflammatory drugs, such as aspirin, advil or mortrin, and aleve

which can damage the inner lining of the digestive tract.

- *Helicobacter pylori*, a type of bacteria that can infect stomach.

Certain factors may put at greater risk of developing a peptic ulcer, including:

1. Taking high doses of NSAIDs (pain killers)
2. Taking NSAIDs regularly for long period of time
3. Steroidal treatment for immunity related diseases can cause peptic ulcers.
4. Being female
5. Being 70 years or older
6. Smoking and drinking alcohol
7. Having a history of peptic ulcers

Other rare causes of peptic ulcers may include serious illness, surgery, or medications other than NSAIDs.

Many people with peptic ulcers don't have any signs or symptoms. If they do, however, upper abdominal pain is the most common one.

The abdominal pain can occur anywhere from navel upto breastbone, and it may follow any of these patterns:

8. Feels worse when stomach is empty
9. Feels better temporarily after eating or taking an antacid
10. Gets worse at night
11. Comes and goes for days or weeks

Less commonly, a severe or complicated peptic ulcer may cause the following symptoms:

4. Nausea or vomiting
 5. Vomiting red or dark blood
 6. Bloody, black, or tar-like stools
 7. Unexplained weight loss
 8. Changes in your appetite
 9. Difficulty breathing
 10. Feeling faint or weak
- Being female
 - Being 70 or older
 - Smoking
 - Drinking alcohol
- Having a history of peptic ulcers

11. 8. 4 DIAGNOSIS OF PEPTIC ULCER

If doctor suspects that one may have peptic ulcer, the next steps include taking a detailed full medical history and performing a physical examination. The clinician may also order the following

diagnostic tests:

1. Lab Test - tool test or a breath test may be performed to determine whether *H. pylori* bacteria are present.
2. Endoscopy - A hollow tube with camera will be passed down throat to esophagus, stomach, and small intestine. It allows doctor to look for a peptic ulcer and take a biopsy (tissue sample) if one is present.
3. Swallowing barium: For this test, patients swallow a white liquid containing barium, which coats digestive tract to make ulcers more visible in a series of X-rays of upper digestive tract.

11. 8. 5 TREATMENT AND DIETARY MANAGEMENT OF PEPTIC ULCER

Course of treatment will be based on the cause of peptic ulcer. Treatment involves taking acid-suppressing medications to kill *H. pylori* bacteria, if present, to promote healing, and stopping any medications that are causing peptic ulcer. Patients may also experience symptom relief from certain lifestyle measures and dietary interventions.

Certain dietary and lifestyle changes may help recover from a peptic ulcer:

1. **Diet:** find out that there are specific foods that make ulcer feel worse, avoid them until treatment is over. For example, those include alcohol, caffeine, fatty foods, spicy foods, chocolate etc.
2. **Stop smoking:** Ulcers take longer to heal, and medications for ulcer treatment may be less effective, if smoking is continued.
3. **Use pain medications with caution:** talk to doctor before taking any of medications; they may continue putting on anta-acid drug to prevent ulcer recurrences.

Dietary Fibre & Vitamin A:

Research shows that a high fibre diet reduces the risk of developing ulcers. As there is a stronger association between diets high in soluble fibre and a decreased risk for developing ulcers.

Foods rich in soluble fibre include legumes, oats, flax seeds, barley, nut and berries, certain vegetables and fruits like oranges, apples, carrots etc.

A diet rich in vitamin A from all sources might reduce the development of duodenal ulcer, as diets high in fruits and vegetables, possibly reduce ulcers due to their fibre content.

Green Tea and Flavonoid-Rich Foods: -Black tea indicated, these teas inhibit the growth of *H. pylori* but cause no harm to beneficial types of bacterias

Flavonoid-rich foods include garlic, onions, and colourful fruits and vegetables such as cranberries, strawberries, blueberries, broccoli, carrots, and peas.

Assess your individual tolerance:

No evidence suggests that eating spicy, oily or citrus foods affect ulcer formation, although individuals find and report worsening of symptoms after eating these foods. It is important to find out what works for individual. If one notice that symptoms get worse after eating some specific type of foods, then limit or avoid them so can feel better, making sure that don't eliminate an entire food group.

Conclusion

In summary, if one suffers from peptic ulcer, the aim is to have a diet high in fibre and rich in

vegetables, fruits, and whole grains. Try for minimum of five to seven servings of vegetables and fruits each day, and a minimum of three to five servings of whole grains. Choose foods which are good source of soluble fibre, vitamin A, and flavonoids.

11.9 FLATULENCE

It is normal phenomenon that everyone passes gas through belching or farting.

Flatulence (also called farting and passing wind), is the passing of gas out of the back passage (rectum/anus) from the digestive system.

Passing wind is normal process for everyone, till its odourless and limited between 5-15 times a day. When this tendency and frequency and foul-smelling flatulence can be socially embarrassing, especially so in a crowded elevator or at an important meeting then need to take some measures for controlling and avoiding it.

Sometimes intestinal gas causes some gas pain or bloating. Most of the time people find gas relief with dietary changes and over-the-counter drugs.

11.9.1 SYMPTOM OF FLATULENCE

Symptoms of excessive flatulence are

1. Passing wind very frequently
2. Smelly and loud passing of wind
3. Abdominal discomfort due to distension
4. Rumbling of lower abdomen

11.9.2 ETIOLOGY OF FLATULENCE

The gas is produced in digestive system by different means, like swallowed air along with swallowing food and drinks or saliva.

Chewing food very fast

Swallowing big chunks of food

Chewing gum

Smoking and sitting for long

Sucking on like pencils, pen tops, or hard candies

Wearing dentures that are loose-fitting etc

Digestion and intestinal fermentation:

Gases are produced in digestive tract as side product of digestion and fermentation and are pushed along the bowel.

Food and drink:

Foods that contains unabsorbable carbohydrates, like high-fibre diets, carbonated drinks, artificial sweeteners, some pungent vegetables (beans, peas, garlic, cabbage, onions and broccoli), fruits (apple, apricot and pear) and dry fruits like raisins and fructose-containing fruit juices may cause high gas formation and flatulence.

11. 9. 3 TREATMENT AND DIETARY MANAGEMENT

Flatulence can be prevented and treated by making changes to diet and lifestyle.

Diet Management

1. Reduce use of dairy and products: low-lactose dairy foods, such as yoghurt, instead of milk.
2. Observe and avoid flatulence-causing foods from daily routine like pungent foods and meats, onion, garlic, beans, broccoli, cabbage, artificial sugars etc.
3. Reduce intake of fried foods and carbonated drinks.
4. Temporarily reduce the intake of high-fibre food that takes too much time to digest.

Lifestyle changes

5. Try small portions of healthy and balance diet.
6. Eat slow and chew food thoroughly, and do not gulp directly
7. Avoid chewing gum, hard candies, and drinking through a straw
8. Dentures need be firm and well set
9. Quit smoking
10. Avoid long sitting hours
11. Regular physical exercise
12. Dietary supplements: Supplements may help improve the digestion and prevent flatulence.
13. Probiotics encourage the growth of friendly bacteria in the digestive system, which help in digestion and reduce flatulence.

11. 10 LET US SUM UP

The gastrointestinal system is essential for digestion, nutrient absorption, and waste elimination, but disturbances like diarrhea, constipation, peptic ulcers, and flatulence can impair these functions. Diarrhea requires rehydration and a low-residue diet, while constipation is managed with high fiber intake, hydration, and physical activity. Peptic ulcers necessitate avoiding irritants like spicy foods and alcohol, alongside small, frequent meals to soothe the stomach lining. Flatulence management involves identifying triggers, avoiding gas-producing foods, and incorporating probiotics. By understanding these conditions and following appropriate dietary and lifestyle strategies, we can effectively prevent and manage GI disturbances, ensuring better digestive health and overall well-being.

11. 11 CHECK YOUR PROGRESS

Short Questions

1. What is the role of enzymes in the digestive system?
2. Name two common symptoms of diarrhea.
3. Define peptic ulcer in one sentence.
4. List two dietary recommendations for managing constipation.
5. What is flatulence, and what causes it?

Long Questions

1. Explain the structure and functions of the digestive system and the role of enzymes in digestion.
2. Discuss the etiology, symptoms, and dietary management of diarrhea.
3. Describe the causes, prevention, and dietary treatment of constipation.
4. Analyze the dietary and lifestyle modifications required for managing peptic ulcers.
5. Elaborate on the causes, symptoms, and nutritional approaches to manage flatulence.

UNIT-12 : NUTRITION IN CARDIOVASCULAR DISEASES

Strucure

- 12. 1 Introduction
- 12. 2 Structure of heart
- 12. 3 Function of heart
- 12. 4 Etiology of Cardiovascular diseases
- 12. 5 Prevention of Cardiovascular diseases
- 12. 6 Atherosclerosis
 - 12. 6. 1 Etiology of Atherosclerosis
 - 12. 6. 2 Symptoms of Atherosclerosis
 - 12. 6. 3 Diagnosis of Atherosclerosis
 - 12. 6. 4 Prevention of Atherosclerosis
 - 12. 6. 5 Treatment of Atherosclerosis
 - 12. 6. 6 Dietary Management of Atherosclerosis
- 12. 7 Hypertension
 - 12. 7. 1 Prevalence of HTN
 - 12. 7. 2 Symptoms of HTN
 - 12. 7. 3 Consequences of HTN
 - 12. 7. 4 Treatment through Lifestyle Interventions
 - 12. 7. 5 Dietary Management of Hypertension
- 12. 8 Congestive Heart Diseases and Heart Failure
 - 12. 8. 1 Types of Heart Failure
 - 12. 8. 2 Causes of Chronic Heart Failure
 - 12. 8. 3 Symptoms of Chronic Heart Failure
 - 12. 8. 4 Nutritional Management of Chronic Heart Failure
- 12. 9 Let Us Sum Up
- 12. 10 Check Your Progress

12. 1 INTRODUCTION

Cardiovascular diseases (CVDs), encompassing conditions such as coronary artery disease, hypertension, heart failure, and stroke, remain a leading cause of morbidity and mortality worldwide. These disorders are often linked to modifiable lifestyle factors, including poor dietary habits, physical inactivity, and tobacco use, as well as non-modifiable risk factors like genetics and age. Nutrition plays a pivotal role in both the prevention and management of CVDs, influencing key risk factors such as cholesterol levels, blood pressure, inflammation, and body weight. Diets rich in heart-healthy nutrients, such as omega-3 fatty acids, fiber, antioxidants, and potassium, are known to reduce cardiovascular risks, while excessive intake of saturated fats, trans fats, sodium, and added

sugars can exacerbate disease progression. Specific dietary patterns, including the Mediterranean diet and DASH (Dietary Approaches to Stop Hypertension) diet, have demonstrated significant benefits in improving cardiovascular health. This chapter explores the critical role of nutrition in cardiovascular disease, focusing on evidence-based dietary strategies to reduce risk factors, improve cardiac function, and enhance overall cardiovascular outcomes for individuals across various stages of the disease spectrum.

12.2 STRUCTURE OF HEART

Heart (size of a clasped fist) is a muscular organ located in chest cavity in between the two lungs. It is placed slightly slanted towards the left in the thoracic region. It is encased by the fluid-filled cavity known as pericardium. The heart wall consists of three layers: Epicardium (outermost layer), Myocardium (middle layer) and the Endocardium (innermost layer).

The heart comprises of four chambers: Two upper chambers include the left and the right atria while two lower chambers include right and left ventricles. The right and the left region of the heart are separated by a wall of muscle called the septum. The ventricles are the chambers that pump blood and atrium are the chambers that receive the blood. The structure of the heart also houses the biggest artery in the body – **the aorta**. The heart pumps blood through a set of connections between arteries and veins through the cardiovascular (or the circulatory) system. The blood vessels comprise of veins which supplies deoxygenated blood to the heart via inferior and superior vena cava into the right atrium. Capillaries are tiny, tube-like vessel forming a network between the arteries and veins whereas arteries (except pulmonary arteries) are muscular-walled tubes which supply oxygenated blood away from the heart to all parts of the body (except lungs)

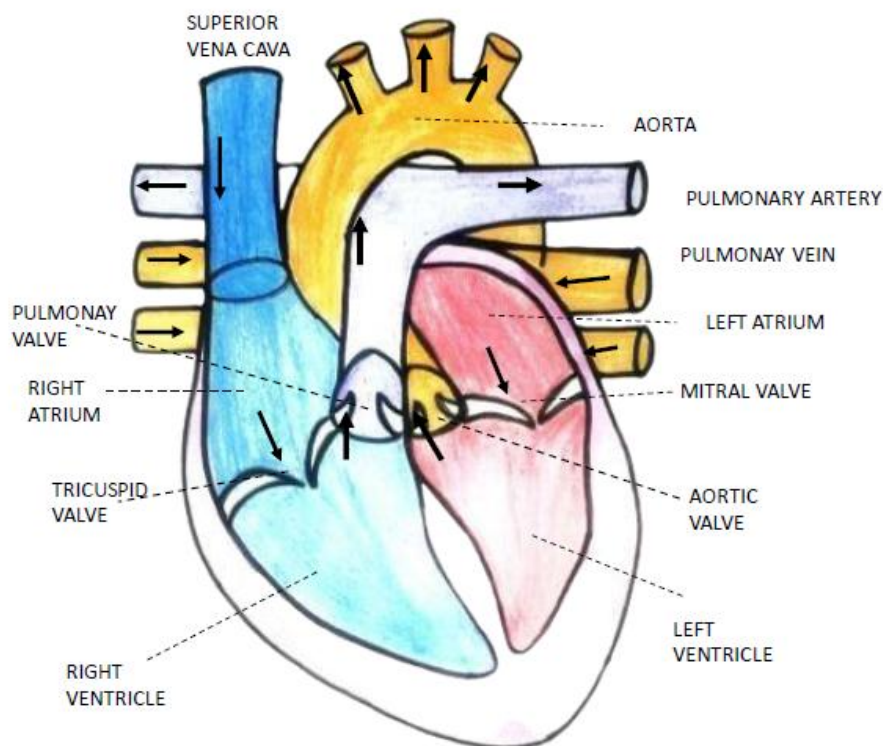


Fig 12. 1: Structure of Heart

Types of Circulation

Pulmonary circulation is a portion of circulation accountable for carrying deoxygenated blood from the heart to the lungs and then bringing oxygenated blood back to the heart.

Systemic circulation is another portion of circulation where the oxygenated blood is pumped from the heart to every organ and tissue in the body and deoxygenated blood comes back again to the heart.

The right ventricle pumps deoxygenated blood to the lungs via pulmonary arteries and pulmonary trunk. The left ventricle pumps newly oxygenated blood to body via aorta. The heart valves act as doors between chambers of the heart and they open and close to allow the blood to flow through. The important valves are:

Tricuspid valve: Atrioventricular valve (AV)	Pulmonary valve	Mitral valve	Aortic valve
It has three leaflets or cusp and it is located between right ventricle and right atrium It opens and closes to ensure that blood flows in the correct direction (from right atrium to the right ventricle) When the right ventricle contracts while sending the blood to the lungs, the tricuspid valve closes to avoid the backflow of blood into the right atrium	a semilunar valve looks like a half moon. It is located at the connection between the pulmonary artery and the right ventricle, and the aorta and the left ventricle. When the right ventricle relaxes pulmonary valve prevents back flow of blood that has been expelled into the pulmonary artery into the ventricles	Mitral valve or bicuspid valve (two cusp) Acts as a door between left atrium and left ventricle Blood flows through atrioventricular valve to left ventricle and cannot go back up into the left atrium.	Aortic valve: a semilunar valve located between the left ventricle and the aorta Blood leaves the left ventricle through this valve and cannot return

Succeeding the blood flow into the ventricle from the atrium, the AV valve snaps shut making the first heart sound (“lub”) of the heartbeat and the “dub” sound is caused by the closing of Semilunar valves

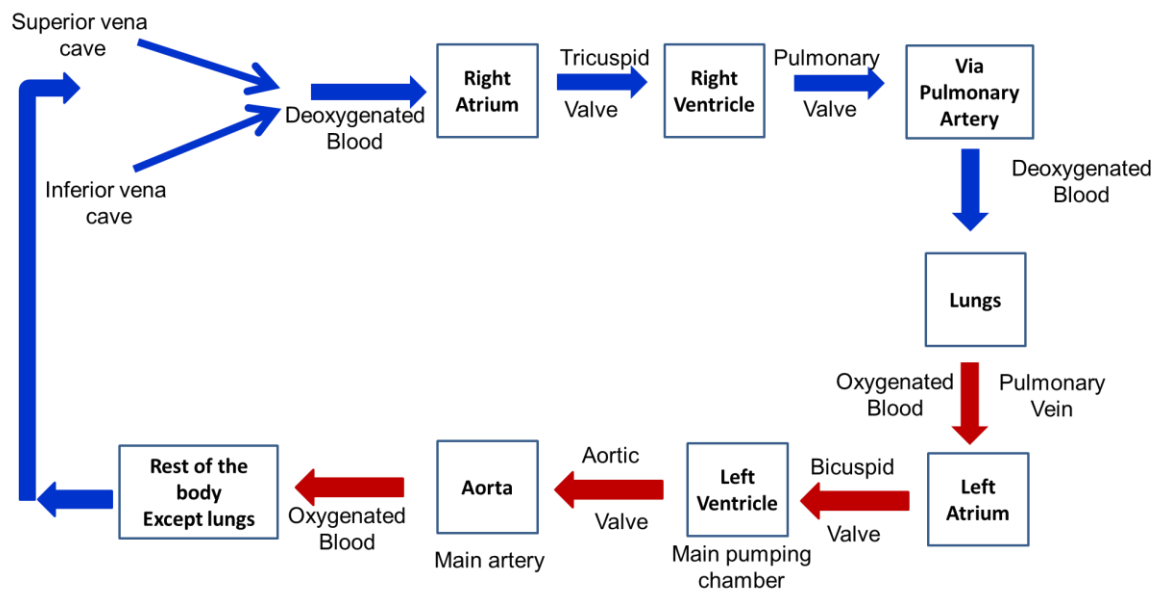


Fig 12. 2 a : Circulatory system

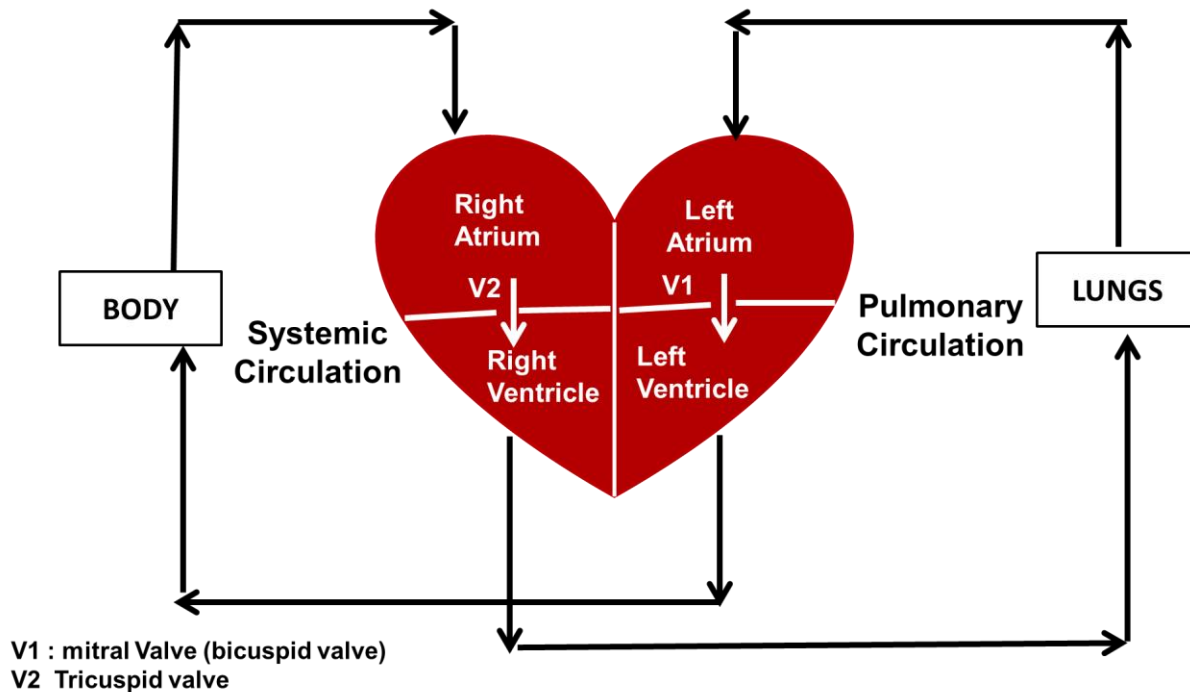


Fig 12. 2 b : Circulatory system

12.3 FUNCTION OF HEART

The crucial function of the heart is to maintain a constant flow of blood throughout the body via cardiovascular or circulatory system. The circulatory system plays a vital role not only in supplying oxygen and important nutrients but also removing the carbon dioxide and other wastes from the body. The heart also safeguards that acceptable level of blood pressure is maintained in the body.

Diagnosis of CVD: Early diagnosis of cardiovascular disease is crucial for prompt appropriate intervention and treatment. It also helps in improving the clinical outcomes, saving lives and help the at-risk patients to adopt a healthy lifestyle and following a well-balanced diet for minimizing the risk

of a heart disease. Besides blood tests and a chest X-ray, many important diagnostic tests are used to diagnose cardiovascular disease. Various diagnostic markers may include:

ELECTROCARDIOGRAM (ECG): It is a most simple, quick, painless and important test frequently used for basic cardiac assessment. It provides the useful information regarding previous damage to the cardiac muscles, enlargement of heart chambers and abnormalities in the electrical system of the heart.

Holter monitoring. It is a portable ECG device that records the heart's activity during daily activities for a day or more and helps in detecting irregular heartbeats that may be missed through a regular ECG

TREADMILL TEST (TMT): it records the ECG while walking on a treadmill machine to assesses the response of the heart to increased workload and demand for blood.

ECHOCARDIOGRAM (Echo): This is a **non-invasive** test done using high frequency sound waves (ultrasound) to take images and measurements of different parts of the heart including the heart valves.

TRANSESOPHAGEAL ECHOCARDIOGRAM (TOE): It is a diagnostic procedure in which a tube with a tiny ultrasound probe is inserted through the patient's mouth and pictures of the heart are obtained using sound waves.

HEAD-UP TILT TABLE TEST: This test is done to identify the cause for dizziness or episodic loss of consciousness with unknown etiology. During the test, patient is tilted head up to a certain angle for up to 45 minutes, while heart rate, ECG and blood pressure is continuously monitored. Any change in heart rate, blood pressure or recurrence of symptoms is carefully observed.

Coronary angiography: It is done to assess the function of the cardiac muscles, heart valves and coronary arteries. A catheter is inserted into an artery and sometimes a vein, in the groin or wrist and guided to the heart (using a dye) to detect the blockages in the coronary arteries.

Blood tests and cardiac biomarkers: lipid Profile, lipoprotein (a), homocysteine, Troponin I, CK-MB, pro BNP, myoglobin etc

Cardiovascular diseases (CVD) are defined as all the diseases associated with the heart and / or the blood vessels or in other words it is a broad term comprising of a spectrum of diseases associated with ailments of the circulation, heart muscles or the vessels of the heart.

CVD have become the foremost cause of mortality in India. In comparison with the people of European ancestry, CVD affects Indians at minimum of ten years prior and in their utmost midlife years. According to the Global Burden of Disease study age-standardized estimates (2010), nearly one fourth (24.8%) of all mortality is assignable to CVD in Indians. Prevalence as well as risk factors of CVD is growing fast placing burden on healthcare systems.

Types of CVD: It may include heart attack (myocardial infarction), angina, stroke, hypertension, congestive heart failure and rheumatic heart disease etc.

Symptoms: CVD may initially cause no symptoms at all. However, typical symptoms of an underlying cardiovascular issue include: pain or pressure in the chest, which may indicate angina pain or discomfort in the arms, left shoulder, elbows, jaw, or back, shortness of breath, nausea and fatigue, light-headedness or dizziness and cold sweats

12.4 ETIOLOGY CARDIOVASCULAR DISEASES

Prevalence of cardiovascular diseases is growing rapidly as well as happening at early age. Risk

factors for CVD are conventionally classified into modifiable and non-modifiable risk factors. Several studies have recognized that control of modifiable risk factors led to considerable reductions in CVD events.

Uncontrollable or non-modifiable Risk factors of CVD: There is no control over these risk factors. Important risk factors include age, gender, race/ethnicity and heredity.

Controllable or modifiable risk factors of CVD: The focus should be on modifiable risk factors which have a lesser but still substantial role. These include high blood pressure, dyslipidemias, diabetes, obesity (especially central obesity), low intake of fruits and vegetables, smoking, tobacco chewing, alcohol, stress, sleep disorders, physical inactivity and sedentary lifestyle. Fortunately, most of these modifiable risk factors can be mitigated or controlled through healthy, balanced diet and an optimal lifestyle.

Goals of dietary management: The goals of dietary management (alone or in combination with regular physical activity or with lipid lowering drugs) are to maintain ideal body weight, maintain normoglycemia, maintain blood pressure, maintain lipid profile within the target range by consuming a diet high in fresh natural seasonally and locally available vegetables and fruits, low fat milk and low fat dairy products, high in dietary fiber, low in total fat, saturated fat, trans-fat and cholesterol, salt and sodium. The consumption of processed meats, refined carbohydrates and sugar sweetened beverages (SSB) should be curtailed for CVD risk reduction.

12.5 PREVENTION OF CARDIOVASCULAR DISEASES

Nutritional care has been provided much importance in the modern era. Most important way for prevention and control of cardiovascular diseases is the promotion of a healthy balanced diet with appropriate portion control and encouragement for adopting an optimal healthy lifestyle coupled with regular physical activity throughout the life.

Several epidemiological and clinical studies have observed that a broad array of CVD (including heart diseases, atherosclerosis, arrhythmias, elevated blood pressure, and cardiac mortality) and obesity are often closely associated. Obesity may have an impact on the incidence, development and progression of cardiovascular disease by impacting on body mass, lipid profile, blood pressure and other risk factors of cardiovascular disease.

Maintaining ideal or desirable body weight: IBW is the term describing the weight that people are expected to have based on age, sex and height. Several formulas are available for calculating ideal body weight. Hamwi is one of the most important formulas used to calculate IBW.

Table 12. 1: Hamwi formula for calculating Ideal Body weight

Male	48 kg for the first 5 feet (152.4 cm) and 2.7 kg for every inch (2.54 cm) after 5 feet
Female	45 kg for the first 5 feet (152.4 cm) and 2.3 kg for every inch (2.54 cm) after 5 feet

The weight corresponding to the BMI 21-22.9 may also be considered as ideal body for Indian population.

Assessment of overweight and obesity: Overweight and obesity are assessed in a variety of ways. The most commonly simplest and easiest used methods may include

- Body Mass Index (BMI) or Quetelet's Index
- Waist circumference and Waist-to-hip ratio (WHR)

1. Body Mass Index (BMI) also known as Quetelet's index is a very simple, useful and easy to use method for estimating the body fatness and gives a more accurate measure of total body fat compared to the assessment of body weight only. BMI can be calculated using the formula:

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

BMI should not be used as the only method for assessing overweight / obesity. The best option is to combine the BMI with simplest measurements like waist circumference for accurate assessment of adiposity. BMI varying between 18.5 and 25 is considered as normal. Though, for Asians Indians it is recommended to maintain the BMI between 18.5 and 23. Indian population is often associated with higher percentage of body fat even at lower BMI as compared to Caucasians and Europeans, they are at higher risk of non-communicable diseases.

2. Waist to Hip Ratio (WHR): Assessment of abdominal fat mass is very crucial. Individuals having similar BMI and total body fat may have dissimilar abdominal fat mass. The WHR (waist circumference divided by hip circumference) is the simple and easy method to differentiate between fatness in the lower trunk (hip and buttocks) and fatness in the upper trunk (waist and abdominal area).

The dissemination of fat around the belly is nowadays considered to be more harmful as compared to the fat distribution around the hips. Higher waist circumference is reflected as an important risk factor. The waist circumference and waist-to-hip ratios are beneficial for the assessing central and truncal obesity respectively. Fat around the waist is recognized as central obesity and considered as a traditional risk factor for development of CVD. Recommendation suggests keeping the waist circumference less than 90 cm for males and below 80 cm for females.

Waist to Hip ratio (WHR): The WHR is obtained by waist circumference divided by hip circumference and is a simplest measure for discriminate between body fatness in the upper and lower trunk.

Table 12. 2: cut off points for waist circumference and WHR

	Caucasian		Asian-pacific			
	waist circumference (cm)		waist circumference (cm)		WHR	
		At risk		At risk		At risk
Male	<102	>102	<90	>90	<0.9	>0.9
Female	<88	>88	<80	>80	<0.8	>0.8

Energy Intake: The recommended energy should be adequate enough to maintain ideal body weight. A balanced, healthy diversified diet with judicious choices (with appropriate portion control) rich in dietary fibers, including low glycemic index foods, adequate in proteins, vitamins, minerals and healthy fat (permitted amount) is vital for maintaining health. The important strategy for weight

reduction in over weight and obese patients is to create a negative calorie balance while maintaining proper balance of all the micro nutrients through planning an appropriate caloric restriction with proper portion control. Carbohydrate, fat and protein are the foremost sources of energy. Simple sugars are unhealthy and should not contribute to more than 10% of total energy while choosing a wide variety of complex carbohydrate from whole grains cereals, millets, legumes and vegetables etc.

Dietary Protein Intake: Protein is one of the most important macronutrients affecting the cardiovascular disease and seems to be inversely associated with it. Quality of protein has more pronounced effect on serum lipoproteins as compared to the quantity of protein. Replacing saturated fatty acids or carbohydrate by proteins has valuable effects on risk factors especially on serum TG, serum LDL level and systolic BP. Vegetable proteins are also rich in dietary fibers, low in saturated fat and are devoid of trans fat and cholesterol. Protein sources like nuts, soya, pulses, legumes and animal source are rich in L-arginine which improves endothelial dysfunction. Consumption of low fat dairy proteins is useful. In case of non-veg eaters' egg, lean meats, skim milk and skim milk products should be preferred.

Low fat milk and milk products like yogurt, mattha / chaach, whey water, hung curd, low fat paneer, eggs, lean meat, fish and chicken are good quality protein whereas beans (green and dry) pulses, legumes, nuts, soya (beans, chunks and granules), mix sprouts are also rich in protein. Vegetarian people can combine two or more vegetarian protein in their diet to improve the protein quality via mutual complementation of various amino acid in different vegetarian proteins.

Carbohydrates (carbs) and CVD: Carbohydrate is an important constituent of Indian diet. It contributes to the major proportion of total daily energy intake in the diet. Complex carbohydrates and simple carbohydrates are two main types of carbohydrates. They differ in terms of how rapidly they are digested and absorbed in the gut. It is indispensable to know the difference between the good (or complex carbs) versus bad carbs (or simple/refined/processed carbs). Majority of carb consumption must be from complex carbs as they are rich in dietary fiber, vitamins and minerals, low in glycemic Index, give satiety on lesser calories, absorbed gradually. Complex carbs are also a good source of dietary fibers, B-complex vitamins, zinc, selenium, phosphorus, folate, magnesium, calcium, iron, potassium, and antioxidants. They help to maintain body weight; blood sugar and blood pressure therefore lower the CV risk factors.

The dietary intake from simple / refined / processed carbs should be limited or restricted as they are energy dense, nutrients poor, low in dietary fiber, minerals, vitamins, have high glycemic index, high glycemic load, digested and absorbed more rapidly hence contribute to weight gain. Substituting these food items with low glycemic index and high fiber foods are important strategy. Sugar sweetened beverages; various carbonated and aerated drinks should be avoided. The food plate should be as colourful and healthier as possible by including a variety of fresh, seasonal and local fruits and vegetables (rich in vitamins, minerals, phytochemicals and antioxidants). Insulin resistance and simple carbohydrates are the driving influences for cardiac disease.

A carbohydrate intake of more than 60% of calorie seems to be associated with higher total and non CVD death. Several studies have reported that a diet high in carbs seems to reduce serum HDL cholesterol levels and upsurge the triglyceride to HDL ratio and the fraction of small LDL contributing to the metabolic syndrome. A diet high in carbohydrate together with high glycemic index foods may contribute to escalation of the risk of CVD. The quantity as well as the quality of carbohydrates has to be selected wisely for prevention and control of cardiovascular disease.

Dietary Fat: All fats are concentrated sources of energy (1 g = 9 Kcal) and must be consumed in moderate amount. A small amount of fat is present in almost every food item known as invisible fat.

There are hidden fat present in the processed and ready-to-eat foods items. The fat in the vegetable oil, desi ghee, and vanaspati used for cooking and preparation of meals contain visible fat. The visible, invisible and hidden fat all together contributes to the total dietary fat intake in the Indian diet. Choosing the amount and quality of fat sensibly is crucial for cardio protective effect.

For CVD prevention, the fat composition of diet is more important than total fat content alone. Using a variety of fats and oils, nuts and seeds in the diet ensures that all the types of fatty acids are consumed and all essential fatty acids are met in the diet. Depending on chemical structure fats are classified into saturated fatty acids and unsaturated fatty acids (monounsaturated fatty acids and polyunsaturated fatty acids)

Saturated Fat	Polyunsaturated Fat	Monounsaturated Fat	Trans Fat
Solid at room temperature Increase levels of total cholesterol and LDL, decrease HDL Plant sources: coconut oil, hydrogenated vegetable oils, palm kernel oil Animal sources: butter, ghee, fats, organ meats, whole milk and its products, cheese, ice-cream, cream, red meat and other fatty meats Stearic acid is a saturated fatty acid found in cheese, fish, dairy, grains, and eggs that is converted to oleic acid, a beneficial omega-9 fatty acid. Stearic acid may be used as a substitute for trans-fats. Multiple studies have shown that it does not increase LDL-C or total cholesterol levels in isolation.	Liquid at room temperature and in the refrigerator Help the body to get rid of newly formed cholesterol. Fish oil, corn oil, sunflower oil, soybean oil, fish, safflower oil,	Liquid at room temperature but start to solidify in the refrigerator Decrease total cholesterol and LDL levels Certain nuts, avocados, canola oil, olive oil, almond oil, groundnut oil, mustard oil, cottonseed oil, sesame oil and nuts	Produced by a process called 'Partial Hydrogenation' whereby a vegetable oil is converted into a semi-solid Not only increases LDL cholesterol but they also decrease HDL cholesterol Snack Foods – crackers, chips, cookies, deep fried foods, biscuits Baked Goods – cakes, pies, pastries, and breads Processed Foods – margarine, salad dressings, potato products, meat products, french-fries and most shortenings Reusing and reheating refined oils increase trans fat (should be avoided) TRFA intake should be <1% of the total energy intake

Sources of α - Linolenic Acid (ALNA) or ω -3 fatty acid: Oily and fatty fishes like salmon, mackerel, sardines, herrings, tuna, fish oils, other oils (such as linseed, rapeseed soyabean, mustard, olive, canola and flaxseed) are important sources.

ALNA can be obtained easily through vegetable sources like wheat, bajra, urad dal, mung dal, lobia, rajma, soyabean, green leafy vegetables, fenugreek seeds (methi), mustard seeds (rai) almonds and walnuts.

LA (Linoleic Acid) or ω -6 fatty Acids: Corn oil, sunflower oil, safflower oil, soyabean oil, cottonseed oil, cereal, pulses and animal fat. It has anti-thrombotic effect which is related to n6/n3 ratio. A modest increase in (ω -3 FA) can easily be achieved if part of total veg oil intake is from mustard oil. A judicious combination of cereals, pulses, vegetables, milk and variety of vegetable oils helps in maintaining a desirable P/S fats ratio ($\sim$ 0.8-1.0). Fat from varied sources is better than any single type but moderate total intake.

Table 12. 3: Alpha Linolenic Acid (Omega-3) Content of Foods (g/100g)

Foods	(g)ALNA
Cereal/Millet	
Wheat & Pearl millet (bajra)	0.14
Pulses	
Blackgram (kalachana), kidney beans (rajmah) & cowpea (lobia)	0.5
Other pulses	0.16
Vegetables	
Green leafy	0.16
Other Vegetables	0.025
Fruits	0.025
Spices	
Fenugreek seed (methi)	2.0
Mustard (sarson)	10.0
Unconventional	
Flaxseed (alsi)	20.0
Perilla seeds (Bhanjira)	33.0

Obtained from Dietary Guidelines for Indians -A Manual NIN, ICMR 2011

Fat and fatty acid intake and CVD: Various epidemiological, clinical and mechanistic studies

have established that risk of coronary heart disease is abridged by 2-3 % when 1% of total calorie intake from saturated fatty acid is substituted with poly unsaturated fatty acid. Therefore, it is recommended to replace the foods rich in saturated fatty acid by monounsaturated/polyunsaturated fatty acid for health benefits. The intake of SFA should not exceed 10 % of the total daily energy intake.

It has also been seen that the replacement of saturated fatty acid or carbs with unsaturated fatty acid has beneficial influence on serum HDL cholesterol level. The intake of trans fatty acid should not exceed more than 1% of the total calorie intake. It has been seen that only 2% increase in the total daily calorie intake from trans fatty acid is linked with a 23% upsurge in the frequency of coronary heart disease.

Dietary fibers are important dietary component having cardio protective effect. Incidence of cardiovascular diseases is lower in people consuming high dietary fiber as supported by a growing number of observational studies. Insoluble fibers have been most consistently associated in lowering the CVD incidence. Eating a balanced healthy and a diversified diet based on whole grain cereals, millets, pulses, legumes, green and dried beans, fresh and seasonal fruits and vegetables and green leafy vegetables (GLVs) will have adequate amount of insoluble and soluble fibers which helps to maintain weight and in turn helps to prevent and control various risk factors of CVD. General public must be educated and encouraged to increase the intake of whole grains, cereals and millets instead of refined grains.

Salt and Sodium Intake: The daily salt should not be more than 5 g of sodium chloride (or about 2 g of sodium)/day. For making a low salt diet palatable natural herbs, condiments and spices can be used as taste and flavour accompaniments. Dietary intake of sodium from sources like pickles, chutneys, namkeen, dals, papads, bakery items, potato chips, popcorn, salty biscuits, preserved meat products, other pre-prepared and preserved foods, soups, cheese, and junk / fast foods should be avoided or limited. Avoid processed foods that have high salt content. The American Heart Association endorses to restrict the sodium to no more than 1,500 mg/day. Limiting it to no more than 2,400 mg/day will improve blood pressure considerably and also decrease the risk for CVD. However various studies across different districts in India have reported that average daily salt intake ranges between 9 and 12 g which is quite high as compared to WHO recommendation of salt intake < 5 g / day.

Read food labels: Everyone should develop the habit of reading the food labels to check hidden sources of dietary sodium. It also helps them to choose foods that have lower amount of sodium. Foods containing more than 400 mg of sodium per serving should be avoided which is equivalent to one gram of salt. (400 mg sodium = 1g Salt)

Consumption of sugar: Consumption of sweetened food /beverages should be kept as minimum as possible or better to avoid. Prefer whole fruits instead of sugary and fatty desserts. It is recommended that dietary intake of sugar and simple carbs should not be more than 10 percent of daily energy intake. However, for cardio protective effects lower intakes are generally better. Simple sugars have adverse metabolic effects and also it contains empty calories.

Fruits and vegetables: The regular consumption of adequate quantity of seasonal vegetables and local, fresh seasonal fruits are essential for cardiovascular health. They are nutrient dense, low in glycemic index, rich in a variety of beneficial micronutrients and other bioactive compounds. They are also low in calories and fat, devoid of cholesterol, saturated and trans fat, high in fiber, vitamins, minerals which provide satiety and have anti-inflammatory properties. Diets rich in green leafy vegetables have significant benefits on CVD risk reduction. Consumption of fruits and vegetables has been inversely linked with the risk for developing hypertension, diabetes and CVD. The

recommendations is to include 5 servings of fruits and vegetables per day. However per capita consumption of fruits and vegetables in India is found to be around ~140 g/ day which is very less. The focus should be on to increase its consumption.

Increasing consumption of other micronutrients: Rainbow diet should be considered; the foodplate should be kept as vibrant and colourful as possible by including lots of vegetables and seasonal low calorie and low glycemic index fruits to improve the nutritional quality and adequacy of diet. Local and regional millets need to be included in the diet as these are rich in numerous micronutrients. Diversified diets with judicious food choices from a variety of food groups provide all the necessary nutrients. Choose healthy snack options (fresh fruits, vegetables and mix sprouts bhel instead of biscuits, cake, pastries, dalmoths, cookies, fried foods, junk and fast foods etc.) Inclusion of local nuts, seeds, spices and herbs may also be included to get both micronutrients and bioactive compounds and phytonutrients.

Managing hyperlipidemia: Limiting foods high in sugar and fat. Portion size control, moderation and variety in diet, maintain ideal body weight or reduce weight (if overweight/obese) and inclusion of regular physical activity avoiding alcohol beer, wine, or hard liquor. Avoid Sugar: candy and regular soda. Prefer complex carbohydrates in place of simple and refined carbohydrates. Replacing some carbohydrates with monounsaturated fats help to lower blood glucose levels and triglycerides

Fruits and vegetables: Vegetables are generally satiating, have a low glycemic index profile, and are rich in a variety of beneficial micronutrients, such as fiber, vitamins, minerals, and phytochemicals. Diets rich in leafy green vegetables have significant benefits on CVD reduction, likely due to multifactorial mechanisms.

These include vascular benefits, such as conversion of inorganic nitrates to nitric oxide, and antioxidant and anti-inflammatory benefits from lutein (carotenoid). Vegetable consumption has furthermore been inversely correlated with the risk for developing hypertension, type 2 diabetes mellitus and CVD. Whole fruits are similarly recommended across a variety of heart-healthy diets due to their antioxidant and anti-inflammatory effects, high satiety profile, and generally low glycemic index. Berries in particular are associated with flavonoids called anthocyanin, which regulate endothelial function and glycemic metabolism, they are nutrient dense with anti-inflammatory components (Low in energy and fat, high in fiber and vitamins and minerals, devoid of cholesterol saturated and trans fats). WHO recommends: 5 servings of fruits and vegetables, In India: per capita consumption of fruits & vegetables is 14g/ day (2 servings/day). Very few trials examining provision of, or advise to increase consumption of fruits and vegetables as a single intervention for the primary prevention of CVD.

Reading food labels: Reading food labels to determine nutrient content of the commercial foods should be encouraged so that hidden sources of sodium and carbohydrates can be identified.

Physical Activity Physical inactivity is considered as bad as smoking. Regular physical activity helps in maintaining ideal body weight. It also reduces the risk of CVD. WHO has recommended that adults and elderly should do at least 150 minutes of moderate-intensity aerobic physical activity throughout the week or do at least 75 minutes of vigorous-intensity aerobic physical activity throughout the week or an equivalent. One must start with short duration activity and gradually increase the duration or intensity. Muscle-strengthening activities on two or more days a week is also beneficial. Physical activity is associated with lower risks which causes mortality and cardiovascular events.

Screen time; Limit TV/Computer time to no more than 2 hours per day.

Quit bad habits: Quitting smoking, tobacco and alcohol consumption is helpful for CVD risk reduction.

Practicing yoga, meditation, relaxation and any other de-stressing therapies or stress buster techniques are also very important for healthy lifestyle.

Appropriate dietary amendment seems to be the cornerstone in the clinical management of CVD prevention. Emphasis should be on adopting a practice of following a diet high in seasonal locally available fruits, whole grains and local millets, legumes, and non-starchy vegetables. Avoid trans-fats, saturated fats, sodium, red meat and refined, processed and ultra-processed carbohydrates, and sugar-sweetened beverages. The Dietary Approaches to Stop Hypertension (DASH), Mediterranean, and vegetarian diets have reported to have significant impact on CVD prevention. Individualized dietary counselling and lifestyle modification is an essential feature of primary and secondary prevention of hyperlipidaemia, hypertension, type 2 diabetes mellitus, and CVD. Prompt and suitable nutritional interventions are vital for gradual and sustainable weight loss and prevention of metabolic syndrome and hence helps in the CVD prevention.

12.6 ATHEROSCLEROSIS

Atherosclerosis is a chronic condition characterized by the buildup of plaques in arterial walls, leading to narrowing and reduced blood flow. It is caused by factors like high LDL cholesterol, hypertension, smoking, diabetes, obesity, and genetic predisposition. Symptoms depend on the affected arteries and may include chest pain, shortness of breath, stroke, leg pain, or kidney dysfunction. Diagnosis involves physical exams, blood tests, and imaging techniques like ultrasounds and angiography. Prevention focuses on a heart-healthy diet, regular exercise, smoking cessation, weight management, and controlling blood pressure and cholesterol. Treatment includes lifestyle changes, medications such as statins and antihypertensives, and surgical interventions like angioplasty or bypass surgery. Dietary management emphasizes reducing saturated fats, trans fats, and sodium while increasing fiber, unsaturated fats, and omega-3s from sources like fatty fish. Early diagnosis and a comprehensive management approach can significantly reduce complications, improving overall cardiovascular health.

12.6.1 ETIOLOGY OF ATHEROSCLEROSIS

Atherosclerosis is a multifactorial disease characterized by the buildup of plaques within the arterial walls, leading to the hardening and narrowing of arteries. The primary etiological factors include elevated levels of low-density lipoprotein (LDL) cholesterol, which infiltrates the endothelium and undergoes oxidation, triggering an inflammatory response. This inflammation attracts macrophages that consume oxidized LDL, transforming into foam cells and forming fatty streaks—the earliest signs of plaque development. Other significant risk factors encompass hypertension, smoking, diabetes mellitus, obesity, and a sedentary lifestyle. Additionally, chronic inflammation, oxidative stress, and endothelial dysfunction contribute to the progression of atherosclerosis by promoting smooth muscle cell migration and proliferation, extracellular matrix deposition, and further lipid accumulation within the arterial wall.

12.6.2 SYMPTOMS OF ATHEROSCLEROSIS

Atherosclerosis is often asymptomatic in its early stages, making early detection challenging. However, as plaques grow and arteries become significantly narrowed or blocked, symptoms begin to manifest depending on the affected vascular beds. In coronary arteries, atherosclerosis can lead to angina pectoris—chest pain resulting from reduced blood flow to the heart muscle—and may culminate in myocardial infarction (heart attack) if a plaque ruptures and forms a thrombus. In the cerebral arteries, it increases the risk of transient ischemic attacks (TIAs) and strokes due to impaired blood flow to the brain. Peripheral artery disease (PAD) caused by atherosclerosis in the limbs results in symptoms like intermittent claudication (pain during walking), numbness, and in severe

cases, critical limb ischemia requiring amputation. Additionally, atherosclerosis in the renal arteries can lead to hypertension and kidney dysfunction. Systemic symptoms may include fatigue and reduced exercise tolerance, reflecting the overall impact of compromised arterial circulation.

12. 6. 3 DIAGNOSIS OF ATHEROSCLEROSIS

Diagnosing atherosclerosis involves a combination of clinical evaluation, imaging studies, and laboratory tests to assess risk factors and the extent of arterial plaque buildup. Clinicians begin with a thorough medical history and physical examination, focusing on risk factors such as hyperlipidemia, hypertension, diabetes, smoking, and family history. Blood tests are essential to measure lipid profiles, including total cholesterol, LDL, high-density lipoprotein (HDL) cholesterol, and triglycerides, as well as markers of inflammation like C-reactive protein (CRP). Non-invasive imaging techniques play a crucial role in visualization and assessment which includes:

- **Ultrasound (Doppler Ultrasound):** Evaluates blood flow and detects plaque in peripheral arteries.
- **Electrocardiogram (ECG) and Stress Testing:** Identify ischemic changes in the heart.
- **Carotid Intima-Media Thickness (CMT):** Measures the thickness of the carotid artery walls as an indicator of atherosclerosis.
- **Ankle-Brachial Index (ABI):** Assesses for PAD by comparing blood pressure in the ankles and arms.
- **Computed Tomography Angiography (CTA) and Magnetic Resonance Angiography (MRA):** Provide detailed images of arterial structures and plaque characteristics.
- **Coronary Artery Calcium Scoring:** Quantifies calcified plaque in coronary arteries using CT scans.

In certain cases, invasive procedures like coronary angiography may be necessary for definitive diagnosis and to guide therapeutic interventions.

12.6.4 PREVENTION OF ATHEROSCLEROSIS

Preventing atherosclerosis centers on modifying risk factors through lifestyle changes and follow pharmacological interventions. Key preventive strategies include:

- **Healthy Diet:** Emphasizing a diet rich in fruits, vegetables, whole grains, lean proteins, and healthy fats (such as those from fish, nuts, and olive oil) while reducing intake of saturated fats, trans fats, cholesterol and refined sugars.
- **Regular Physical Activity:** Engaging in at least 150 minutes of moderate-intensity aerobic exercise per week to improve cardiovascular health and maintain a healthy weight.
- **Smoking Cessation:** Eliminating tobacco use to reduce endothelial damage and inflammation.
- **Weight Management:** Maintaining a healthy body mass index (BMI) to lower the risk of hypertension, diabetes and dyslipidemia.
- **Blood Pressure Control:** Managing hypertension through lifestyle modifications and medications as prescribed.
- **Diabetes Management:** Keeping blood glucose levels within target ranges to prevent vascular complications.
- **Cholesterol Management:** Using dietary strategies and medications like statins to maintain

optimal lipid levels.

- **Stress Reduction:** Incorporating stress-reducing techniques such as mindfulness, meditation, and regular physical activity.

Public health measures and education aimed to promote lifestyle changes are essential for reducing the prevalence and impact of atherosclerosis in the population.

12. 6. 5 TREATMENT OF ATHEROSCLEROSIS

The treatment of atherosclerosis involves both lifestyle modifications and medical or surgical interventions aimed at reducing symptoms, preventing complications, and halting disease progression. Medical management includes:

- **Pharmacotherapy:**
 - **Statins:** Lower LDL cholesterol levels and stabilize plaques.
 - **Antihypertensives:** Control blood pressure to reduce arterial stress.
 - **Antidiabetic Agents:** Manage blood glucose levels in diabetic patients.
 - **Antiplatelet Agents (e. g. , aspirin):** Prevent thrombus formation.
 - **Beta-Blockers and ACE Inhibitors:** Improve heart function and reduce cardiac workload.
- **Lifestyle Interventions:**
 - **Dietary Changes:** Adopt a heart-healthy diet as outlined in prevention strategies.
 - **Exercise Programs:** Implement regular physical activity tailored to the patient's condition.
 - **Smoking Cessation Programs:** Provide support and resources to quit smoking.
- **Surgical and Interventional Procedures:**
 - **Angioplasty and Stenting:** Open narrowed arteries and place stents to keep them open.
 - **Coronary Artery Bypass Grafting (CABG):** Create alternative pathways for blood flow around blocked arteries.
 - **Endarterectomy:** Surgically remove plaque from arteries, commonly performed on carotid arteries to prevent stroke.

Early and aggressive treatment is crucial to prevent adverse outcomes such as heart attacks, strokes, and peripheral artery complications.

12. 6. 6 DIETARY MANAGEMENT OF ATHEROSCLEROSIS

Dietary management is a cornerstone in both the prevention and treatment of atherosclerosis, focusing on reducing lipid levels, controlling blood pressure, and minimizing inflammation. Key dietary strategies include:

- **Reducing Saturated and Trans Fats:** Limit intake of red meats, full-fat dairy products, and processed foods containing hydrogenated oils to decrease LDL cholesterol levels.
- **Increasing Healthy Fats:** Incorporate sources of unsaturated fats, such as olive oil, avocados, nuts, and fatty fish rich in omega-3 fatty acids, which help lower triglycerides and reduce inflammation.

- **Enhancing Fiber Intake:** Consume ample soluble fiber from oats, beans, lentils, fruits, and vegetables to help lower cholesterol levels and improve gut health.
- **Emphasizing Plant-Based Foods:** A diet rich in fruits, vegetables, whole grains, and legumes provides essential nutrients and antioxidants that protect against arterial damage.
- **Limiting Dietary Cholesterol:** Reduce consumption of high-cholesterol foods like organ meats, shellfish, and egg yolks to manage blood lipid levels.
- **Reducing Sodium Intake:** Lower salt consumption to help control blood pressure, aiming for less than 2,300 milligrams per day, and ideally around 1,500 milligrams for those with hypertension.
- **Moderating Sugar and Refined Carbohydrates:** Decrease intake of sugary beverages, sweets, and refined grains to prevent insulin resistance and obesity.
- **Incorporating Antioxidant-Rich Foods:** Foods high in vitamins C and E, selenium, and flavonoids help combat oxidative stress and inflammation within the arteries.
- **Maintaining Adequate Protein Intake:** Choose lean protein sources such as poultry, fish, legumes, and plant-based proteins to support overall health without contributing to lipid abnormalities.
- **Alcohol Moderation:** If consumed, alcohol should be limited to moderate levels—up to one drink per day for women and two for men—to avoid adverse cardiovascular effects.

Adhering to these dietary principles not only aids in managing atherosclerosis but also promotes overall cardiovascular health, reducing the risk of recurrent events and enhancing quality of life.

12.7 HYPERTENSION

Hypertension (HTN) is characterized by high blood pressure. Blood pressure (BP) is the force circulating blood against the inner walls of blood vessels. When blood flows through the blood vessels with a force more than that considered healthy for an individual is known as HTN. Majority of people are living a sedentary lifestyle and having a faulty eating/ dietary habit leading to increase in the incidences of HTN and is now considered to be one of the major risk factors for coronary artery disease, heart failure, kidney failure and other medical complications.

About 1/3rd world's adult population are hypertensive and is a major cause of premature mortality in spite of considerable progresses in medicinal treatments but fortunately growing evidences also support the use of various dietary and lifestyle interventions for the prevention and supportive treatment of HTN.

Blood pressure measures the force of blood against the walls of the arteries. Systolic means the pressure while the heart beats whereas diastolic pressure is measured as the heart relaxes. Hypertension is continuous elevation of blood pressure. Hypertension is defined as systolic blood pressure (SBP) $\geq$ 140 mmHg, diastolic blood pressure (DBP) of $\geq$ 90 mmHg, or person on antihypertensive medications.

12.7.1 PREVALENCE OF HTN

It is predictable that nearly 140 million people are hypertensive and projected number for 2030 is 214 million in India. Nearly one third of the males and females (33% males and 32% females) more than 25 years are hypertensive and several others lie in pre-hypertensive stage.

There seems to be an increase in the prevalence of hypertension with the recent modifications made in the international guidelines for diagnosis of hypertension. According to the guidelines from

ACC/AHA (2017), the threshold to define hypertension has now been recognized at 130/80 mmHg, with stage 1 HTN defined as office systolic BP (SBP) of 130–139 mmHg and stage 2 HTN defined as office SBP of ≥ 140 mmHg. As per the guidelines by ESC/ESH (2018) a SBP of 130–139 mmHg is defined as 'high– normal'. So going along with these recent guidelines, several individuals who were not formerly receiving medication might now be placed on treatment. This leads to an upsurge in the number of individuals treated for hypertension in the near future.

12. 7. 2 SYMPTOMS OF HTN

As per clinical manifestation, hypertension is considered as no specific complaints other than raised systolic and/or diastolic BP. Some persons may complain about symptoms like morning occipital headache, dizziness or fatigue. In severe HTN, epistaxis or blurred vision may occur. HTN is considered as silent killer and it often occurs without any obvious symptom or warning signs until more serious problem arises. In order to avoid undesirable conditions monitoring of blood pressure is crucial. It is essential to follow a healthy diet and lifestyle for the prevention and control of HTN.

12. 7. 3 CONSEQUENCES OF HTN

Adverse complications like stroke, hypertension encephalopathy, blindness, heart attack or heart failure or kidney failure may be caused by persistence of elevated blood pressure. Unfortunately, these undesirable problems may happen suddenly without any warning. So, it is recommended to keep the blood pressure under target range to avoid major health related consequences.

12. 7. 4 TREATMENT THROUGH LIFESTYLE INTERVENTIONS

The promotion of lifestyle interventions especially regular exercise, maintenance of ideal body weight or weight reduction in persons with obesity requires a healthy diet recommendation. All these aimed at optimizing the prevention and management of HTN.

The ESC/ESH guidelines put the emphasis on optimal lifestyle as the only treatment required for mild hypertension during the initial 3–6 months postdiagnosis, with the commendation that medicinal treatment may be added after this duration if HTN is not well controlled. Adopting and following important measures like DASH diet, maintaining IBW, reducing salt and dietary sources of sodium, reducing high fat diet especially trans fats, avoiding alcohol, tobacco and smoking is very important in preventing and controlling HTN.

As per endorsements by joint nutrition committee JNC, 7/8 Several interventions including the DASH diet, sodium reduction, weight reduction and limiting or avoiding alcohol intake, quitting tobacco and smoking have been shown to reduce blood pressure in patients with HTN and pre-HTN. It is recommended to eat a healthy, balanced and a diversified diet that is high in whole grains cereal and millets, pulses and legumes, fresh fruits and vegetables, and low fat dairy products and so it is lower in fat, saturated fat, trans fat and adequate in potassium, calcium and magnesium. Besides eating a healthy diet, moderate level of physical activity at least 30–45 min/day or most days of the week is helpful. Distress therapy is also vital in prevention and control of blood pressure.

Physical Activity is very vital for prevention and control of HTN. A minimum of 30–45 minutes of physical activity of moderate intensity (such as brisk walking 5–6 km/hour) at least 5–6 days of the week is important. One must be encouraged engaging in physical activity of longer duration or more vigorous intensity such as jogging, running, cycling and swimming if possible. One can start with short duration and gradually increase the duration or intensity.

Stress management: Stress and anxiety may cause a temporary rise in blood pressure so try to reduce any type of stress through yoga or meditation or any other de-stressing practices as per one's choice.

Screen time: Limiting screen time is vital especially high screen use at night must be avoided. Maintaining circadian synchrony is also very crucial with regular sleep wake cyclic and regular meal timings.

Table: The expected systolic BP reduction by various lifestyle interventions

Intervention	Recommendation	Expected systolic BP reduction (range)
Weight reduction	Maintain ideal BMI (20-25kg/m ²)	5-20 mmHg /10 kg weight loss
DASH eating plan	diet rich in fruit, vegetables, low-fat dairy product low in saturated and total fat	8 -14 mmHg
Dietary sodium restriction	Reduce dietary sodium intake to <100mmol/day <2. 4g sodium or <6 g salt (sodium chloride)	2 - 8mmHg
Physical activity	Regular aerobic physical activity, e. g. brisk walking for at least 30 min most days	4 - 9 mmHg
Alcohol in moderation	Men ≤ 21 units per week Women ≤ 14 units per week	2-4 mmHg
Dietary and exercise: reduce BP by at least 10 mmHg in about 1 out of 4 people with high BP		

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12. 7. 5 DIETARY MANAGEMENT OF HYPERTENSION

Overweight or obesity is one of the most important risk factors for development of ofhypertension. Maintenance of desirable or ideal body weight (IBWt) is important.

Energy: Adequate energy to maintain IBWt or desirable body weight or lose weight if overweight or obese.

Protein: Normal protein is needed (0. 8-1 g/kg/IBW) in the diet. Plant based protein sources seems helpful.

Fat: It should contribute to not more than 20-30% of the total caloric intake. In case of very obese patients' further reductions can be done.

Dietary fibers: Soluble as well as insoluble fibers must be included in our daily diet. The soluble fibers includebeans, seeds, citrus fruits, apple, nuts, oats, oat bran, barley, and many vegetables. Sources of insoluble fibers include whole wheat, legumes, fruits and vegetables, whole grain cereals, millets and their products etc. Eating a balanced healthy and a diversified by wisely selecting foods

from all food groups as per recommendations will provide adequate dietary fibers in daily diet which helps to maintain weight and in turn helps to prevent and control hypertension.

Salt and Sodium: A reduction in sodium intake is one of the most popular recommendations for the dietary management of HTN and is considered as an effective strategy for reducing BP in hypertensive patients. Restricting dietary sodium and increase in potassium to sodium ratio in diet is very crucial. Moderate sodium restriction 2-3g / day reduces diastolic pressure 6-10 mm Hg. Sodium restriction accompanied by weight reduction effectively control mild to moderate blood pressure.

It is advisable to reduce daily salt intake to <5g or <90mmol / day (with no added salt) while maintain the palatability of diet.

Conversion of salt into Sodium: The American Heart association recommends consuming no more than 1,500 mg of sodium per day and cutting it back to no more than 2,400 mg/d will significantly improve blood pressure. Sodium chloride or table salt is approximately 40% sodium by weight. One teaspoon or 5g of salt will have 2000 mg of sodium or around 87 mmol of sodium as equivalent weight of sodium is 23. In that way amount of sodium in particular g of salt can be calculated.

Practical aspects of reducing salt and sodium in daily diet: Reducing salt in cooking and preparation of meals over a period of time so that the taste buds get adapted. Meals should be prepared using the fresh ingredients and then adding a permitted amount of salt but none subsequently cook without salt and add the prescribed amount later on. Limiting or avoiding ready to eat foods, processed or canned foods or smoked meat and fish or other such products, food items prepared and cooked using Mono Sodium Glutamate (MSG). Avoid using baking soda, baking powder and MSG in daily preparation and cooking of foods as they also contain high sodium. Spices herbs and condiments can be added to make low salt diet palatable. Develop the practice of reading food labels to check the hidden sources of dietary sodium in various foods. This will help to choose foods that have lesser amount of sodium. Avoid foods containing > 400 mg Na / serving.

Dietary Approaches to Stop Hypertension (DASH) diet: It exerts a protective effect against blood pressure. The DASH diet comprises of the foods sources rich in potassium, calcium and magnesium, protein and fibre but low in saturated fat, trans fat, cholesterol, sugar and refined carbs. It is usually high in fresh fruits, vegetables, whole grains, legumes, nuts and low-fat dairy and dairy products, It stresses on the intake of fish and chicken rather than red meat, processed meats and sugar-sweetened beverages. The DASH diet with 2300 mg of sodium can lower blood pressure and 1500 mg of sodium may further reduce the blood pressure. The recommendation is to augment the dietary potassium intake to 3500 mg per day. Foods rich in dietary sodium should be limited or avoided. All individuals should be encouraged to eat at least 400-500 g per day of seasonal vegetables and fruits. A word of caution is that DASH diet should not be used for CKD patients or in patients with hyperkalemia (high serum potassium level).

Other important nutrients for prevention of HTN: calcium, potassium and magnesium food sources have protective effects. Dietary sources of calcium include milk and milk products, pulses, vegetables and greens beans, green leafy vegetables, fish, nuts, dried fruit or foods made with fortified flour, fortified soya milk and other soya products, e. g. tofu. Dietary sources of magnesium are nuts, beans, vegetables, legumes, cereals, animal products and dietary sources of potassium consist of fruits and vegetables. Studies have shown that high potassium to sodium ratio is often associated with normal blood pressure.

12.8 CONGESTIVE HEART DISEASES AND HEART FAILURE

It is a clinical syndrome that can result from any structural or functional cardiac disorder impairing ability of ventricle to fill with or eject blood. It occurs when the heart does not pump proficiently and

does not deliver enough oxygen to the body. Heart failure remains one of the foremost reasons of frequent hospitalization. Heart failure is considered as one of the major burdens on the health care in terms of morbidity, mortality and cost.

12. 8. 1 TYPES OF HEART FAILURE

Chronic Heart Failure (CHF) is often classified into heart failure with reduced ejection fraction (HFrEF or systolic failure; most commonly happens when the left ventricle loses its ability to contract efficiently) and heart failure with preserved ejection fraction (HFpEF or diastolic failure; mainly occurs when the left ventricle cannot relax normally), decreasing the ability of the heart to fill. Heart failure with preserved ejection fraction is more frequent in elderly adults.

12. 8. 2 CAUSES OF CHRONIC HEART FAILURE

The most common etiology of CHF is advanced age, high blood pressure, coronary artery disease, other heart diseases, genetic or viral cardiomyopathy, kidney failure, left ventricular hypertrophy, diabetes mellitus, arrhythmias, alcohol intake, tobacco and drug abuse or excessive intake of salt and foods rich in sodium. These conditions may lead to the progressive weakness of the cardiac muscles and hence the heart may not be able to maintain normal cardiac output.

12. 8. 3 SYMPTOMS OF CHRONIC HEART FAILURE

The type and severity of signs and symptoms may vary from patient to patient depending on the stages of HF or degree of compensation or decompensation. The most common symptoms are breathlessness because of pulmonary edema, edema of feet and legs, swelling in abdomen, palpitation, cough, fatigue, difficulty in sleeping at night resulting in shortness of breath, dizziness, weakness, anorexia, nausea, vomiting, congestion, reduced exercise capacity, orthopnea (dyspnoea) on exertion, decreased cardiac output and volume overload, sometimes worsening cough, atrial fibrillation and ventricular dysrhythmia may also be observed. The heart failure symptoms may vary from mild to severe. The symptoms may appear and subside depending on treatment and response of the patients.

12. 8. 4 NUTRITIONAL MANAGEMENT OF CHRONIC HEART FAILURE (CHF)

A multidisciplinary approach is considered to be of paramount importance in the clinical management of heart failure as the prevalence of heart failure is increasing with time. Overweight/obesity and malnutrition and/or macro- and micronutrient deficits are predominant in heart failure and it may have impact on disease trajectory therefore the dietary management of CHF patient is complex and often involves the challenge of managing multiple conditions requiring multiple medications and life style changes. It is recommended that dietitians should be an important part of multidisciplinary team for giving individualized, realistic and patient friendly meal plan and dietary counselling for every patient with regular follow-up on-going basis with diet diaries for assessing dietary compliance.

Dietary Goal in CHF should be

- To reduce myocardial workload
- To maintain IBW, optimize nutritional status and prevent cardiac cachexia
- To meet macro and micronutrients
- To alleviate associated symptoms and improve quality of life
- To prevent fluid overload and electrolyte imbalance
- Imparting continuous nutrition education to patient and care givers

- Disseminating knowledge on proper understanding of food and drug interaction
- Salt restriction and fluid balance depending on the symptoms

A sensible and cautious synchronization between pharmacological therapies in conjunction with nutritional management, balancing drug-nutrient interaction may aid in improving or preventing many of the symptoms accompanying CHF. Thus, it helps in decreasing the associated incidence of morbidities and mortalities.

Management of body weight in CHF: Trying to maintain a healthy or ideal body weight throughout the life time considerably reduces the risk of developing heart failure among obese patients. CHF patients should be weighed regularly using the SAME approach – same scale, same time, same amount of clothing. Weight gains of over 1 kg in a 48-hour period or 2.5 kg in one week should be reported to avoid fluid overload. Conversely, if the patient loses a similar amount of weight over the same period should also be reported to avoid dehydration due to over-diuresis. In that case adjustment in diuretics, fluid and salt intake may be required.

Obesity has a prevalence of 30–40% in HF with a reduced ejection fraction (HFrEF) and 40–55% in HF with preserved ejection fraction (HFpEF), making these conditions a challenge. In the case of body weight loss, the focus should be on the quality of the weight lost, and whether it is adiposity or involves muscle mass.

According to the European Society of Cardiology (ESC), weight loss cannot be recommended in patients with moderate obesity, which is in line with the recommendation of the American Heart Association (AHA). In advanced obesity, weight loss manages symptoms and exercise capacity. To address this issue, in clinical practice, it is common to recommend a negative energy balance of 500–750 kcal/d or an absolute intake of 1200–1500 kcal/d for women and 1500–1800 kcal/d for men, aiming for a loss of at least 5–10% of the weight at baseline.

Energy: Calorie requirements are based on residual cardiac function and ideal body weight. It has been observed that ambulatory and normal weight patients are able to tolerate around 25 Kcal/kg IBW or UBW/day. However, in obese patient's hypocaloric diets 1000-1200 Kcals may reduce stress or myocardium load. Moreover, patients with cardiac cachexia may require 1.6-1.8 times of resting energy expenditure (REE) for repletion. In case of severely undernourished patient's calorie intake should be increased gradually as increased food intake would impose enhanced burden on the heart.

Adequate amount of dietary protein intake (0.8-1.0g/kg IBW or UBW) should be recommended by including good amount of proteins particularly of HBV to facilitate tissue synthesis and prevent malnutrition. Emphasis needs to be laid on judicious combination of plant proteins (low in Na compared to animal proteins) to improve the protein quality.

Carbohydrates: About 55- 60% of the energy should be from carbohydrate and quality of carbohydrate needs to be modified as per presence of the associated symptoms.

Meals: Small amounts of food to be given as 5-6 meals (small frequent meals) and are preferable bulky, large meals. When decomposition occurs: liquid / soft, easy to digest foods requiring little or minimum mastication may be used. The diet must be low in dietary fiber and should also provide good amount of simple carbs (semolina, refined flour, de-husked pulses, papaya, mango, brinjal, pumpkin and other gourd family vegetables).

During the severe decomposition, as in coronary occlusion, the principal consideration should be rest and all attempts to feed the patient should be avoided. Sodium is restricted to 500mg.

Salt Sodium and fluid intake: A high salt intake may aggravate symptoms and thereby increase disease progression. Sodium restriction with or without simultaneous fluid restriction is considered

as the most extensively used dietary intervention in CHF patients. Individualized dietary counselling on low-sodium diet, restricting fluids together with appropriate drugs and medications may prolong survival, improve function of the heart, ameliorate symptoms, avoid repeated episodes of decompensation, and decrease incidences and frequency of hospitalization,

Most evidence supports a moderate level of salt restriction to 2,000-3,000 mg/day. Fluid restriction should not be routinely recommended to all heart failure patients. Temporary fluid restriction is needed in decompensated heart failure and /or in dilutional hyponatremia. The Heart Failure Society of America (HFSA) prescribed a salt restriction of less than 2,000 mg per day in moderate to severe heart failure and a muchstringent low salt intakes of 1500 mg/day in stage A and stage B HF. An abrupt increase in salt intake causes a rapid increase in extracellular volume and may precipitate left ventricular failure (LVF) even in a well-compensated heart failure. So sensible eating is crucial. A positive sodium balance serves as the primary driver of water retention and ultimately volume overload.

Restriction of fluid is not required as long as the sodium is restricted. Water is retained only when there is sufficient sodium to maintain physiologic concentrations. Fluid restrictions are generally reserved for individuals taking high doses of diuretics or patients who have recurrent CHF. Maintain restricted sodium diet even if serum sodium depleted; sodium has moved from blood to tissues. Careful evaluation of serum sodium in conjunction with volume overload is needed. If hyponatremia occurs limit total fluids to less than 2000 ml.

There is no rationale for routine fluid restriction in stabilized patients with mild to moderate heart failure. Fluid restriction of 1. 5–2 L/day may be considered in patients with severe symptoms, particularly if they have concurrent hyponatremia. Limit total fluid to 1000-1500 ml in case of severe decompensation, weigh every day to monitor fluid status assessment.

Personalized approach in terms of moderation of salt, sodium and fluid restriction seems useful. Continuous nutritional education is vital to sustain fluid and salt balance in HF

Management of Fluid balance: Handling a fluid or volume overload is an important issue in heart failure patients whereas the management window between dehydration and over hydration is narrow. The main aim is to restore fluid balance without risking further decline in cardiac performance and stroke volume.

Dietary recommendations for heart failure have conventionally focused on sodium and fluid restrictions. Patients and care givers must be educated continuously regarding the common household measures like how much common household cup, mug, bowl and glass etc hold. Record of all the fluids consumed including water, coffee, tea, milk, curd, mattha, juices, soups, vegetable gravies, rasam, coconut water, thin gravies, thin daals, porridge, desserts and any other liquids consumed must be documented. During episodes of fluid retention, patients should be encouraged to reduce fluid intake. Fluid restriction varies noticeably and each patient must be managed individually.

Potassium Intake: Potassium wasting diuretics (hydrochlorothiazide, furosemide) increase potassium excretion. A good source of dietary potassium is important if the patient is on diuretics (non-potassium sparing). Potassium intake is recommended unless using K sparing diuretics (Aldactone). Salt substitutes are contraindicated in renal failure and with certain other medications. It is Important to monitor a patient's potassium level as excesses of the potassium may be just as harmful as deficiencies.

Appropriate lifestyle modification: It is critical to maintain a healthy diet and lifestyle. Patients must be encouraged to eat a low-sodium/low salt diet. Desirable weight has to be maintained and weight reduction is needed in overweight or obese patients for reducing myocardial load. Eliminate alcohol and quit smoking.

Dietary Patterns

ESC guidelines emphasize on fluid intake, regular weight monitoring, avoidance of extra salt and alcohol intake along with the adoption of common dietary guidelines for preventing CVD (as discussed in diet in CVD section).

Other Nutritional issues: Half of patients with severe heart failure have osteopenia or osteoporosis, especially cachectic patients. Calcium and vitamin D should be supplemented. Calcium supplements have to be given with caution in patients with cardiac arrhythmias. Monitor serum magnesium level, blood mg levels as diuretics may increase magnesium excretion; Thiamine status should be evaluated in patients on loop diuretics. Micronutrient deficiencies may be associated with heart failure attributed to anorexia, diuretic use, renal dysfunction, comorbidities induced dietary restrictions and medications altering gut health. Atrial Fibrillation (AF) is common in heart failure patients where dietary vitamin K is restricted if patient is on acitrom or on warf. All the nutritional deficiencies have to be identified and rectified.

Endorsements for dietary management of heart failure have traditionally been focused on the restriction of salt, sodium and fluid. However, emerging data supports the role of moderate sodium and fluid restriction, using a personalized approach. The use of individualized nutritional support, compared with standard recommendations, has shown effectiveness, especially in high-risk patients. Heart failure patients may do well by following low sodium, restricting fluids and nutritionally balanced diet along with prescribed medications. Individualization of fluid intake is crucial to maintain euvolemic state. Personalized, supervised tailored nutritional intervention, nutrition education and appropriate weight management is important to improve nutritional status, clinical outcomes and quality of life in heart failure.

12.9 LET US SUM UP

Cardiovascular diseases (CVDs) encompass a range of conditions affecting the heart and blood vessels, including hypertension, congestive heart disease, and heart failure. The heart's structure, with its chambers, valves, and blood vessels, functions to pump oxygen-rich blood throughout the body, maintaining vital organ health. CVDs arise from risk factors such as hypertension, high cholesterol, diabetes, smoking, obesity, sedentary lifestyles and genetic predisposition. Symptoms vary from chest pain, breathlessness, and fatigue to swelling in extremities or irregular heartbeats. Diagnosis involves physical examinations, blood tests, ECG, echocardiography, and imaging techniques like angiography. Prevention emphasizes healthy lifestyle choices—balanced diets, regular exercise, weight control, smoking cessation, and stress management. Treatment includes medications like antihypertensives, statins, and anticoagulants, along with surgical interventions like stenting or bypass surgery when necessary. Dietary management is key, focusing on reducing sodium, saturated fats, and trans fats while increasing intake of whole grains, fruits, vegetables, lean proteins, and heart-healthy fats like omega-3s. Holistic care, combining prevention, treatment, and dietary strategies, helps mitigate risks, manage symptoms, and improve quality of life in CVD patients.

12.10 CHECK YOUR PROGRESS

Short Questions

1. What is the primary function of the heart?
2. Define atherosclerosis in one sentence?
3. Name two common symptoms of hypertension?

4. What is congestive heart failure?
5. List one dietary recommendation for managing heart diseases?

Long Questions

1. Explain the structure and functions of the heart and how they are impacted by cardiovascular diseases?
2. Discuss the etiology, symptoms, and dietary management of atherosclerosis?
3. Describe the causes, prevention, and treatment strategies for hypertension?
4. Analyze the dietary considerations for managing congestive heart disease and heart failure?
5. Elaborate on the role of nutrition in preventing and managing cardiovascular diseases.